








Enatel Motive Power Ltd

Charger Interface

Software Description and User Manual
Revised October 2014



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1. Introduction to Charger Interface

1.1. Uses

The Charger Interface software allows configuration of any FSx series charger by PC connectivity via the charger's front panel USB port.

Common uses for Charger Interface include:

Configuring a charger or battery module for first use.

Retrieving charge and alarm logs from a charger or battery module.

Reconfiguring a charger for a different battery type.

Adjusting charge profile parameters.

Upgrading charger or battery module firmware (bootloading).

1.2. System Requirements

Charger Interface has the following minimum system requirements:

Microsoft Windows XP(SP3)/Windows Vista/Windows 7/Windows 8

Microsoft .NET Framework

USB 1.0/1.1/2.0

Administrator privileges on the PC for installation.

1.3. Installation

Ensure the minimum system requirements are met before installing Charger Interface.

The software installer may be supplied on a CD, USB flash drive or other distribution method.

Locate and run the software installer file. Follow the installer prompts to complete the install.

The installer will create a desktop shortcut to run Charger Interface.

1.4. Connecting to the Charger

Power on the charger and connect the charger to the PC with a USB cable.

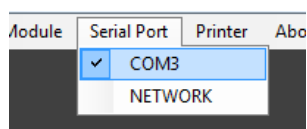
Ensure the Charger Interface software is installed *before* connecting the charger via USB.

- A successful USB connection can be confirmed by the charger serial number and firmware version displaying in the window title bar.

For example:

"(Charger: MPC35 0123456789 V51)".

- If a connection is not made within 30 seconds, ensure the correct COM port is selected from the **Serial Port** menu (Figure 1). If connectivity is still not established, remove and reinsert the USB cable.



1.6. Operator Access Level Control

An incorrectly configured charger can cause irreversible damage to batteries. For this reason Charger Interface employs a three-level access control system to limit access to advanced features and parameters. The default level is **Read Only**.

To access levels beyond **Read Only**, a password is required (supplied by the distributor). This can be entered in the **About Charger Interface** box from the **About** menu.

Read Only Access

Read charger status, charger-battery configuration, start and delay times, and alarm and charger logs from the charger. Viewing the configuration of an attached battery module is also possible.

Configuration Access

User can modify battery configuration settings on the charger and any connected battery module using pre-defined template settings only.

Advanced Access (🔒)

Allows advanced control over the charger and battery module functions. Access to view and edit charge profiles, advanced control over charger controller and charger module settings is possible including charger firmware bootloading and relay configuration.

1.7. Charger Interface Read/Write Functionality

Charger Interface can read a charger or module configuration and display on screen and, depending on access levels, write any changes back to the charger.

Live Feed

It should be noted that only the Monitoring tabs for charger and battery modules provide a "live" feed of updating information.

Read/Write

In all operations involving modifying a charger or module configuration, the "Read" or "Refresh" buttons should be used

first to ensure the visible parameters and settings accurately reflect the current configuration in the device.

Similarly, any modifications or adjustments should always be followed by clicking the appropriate "Write" button ensuring the parameters are written back to the charger.

1.8. Battery Modules

A battery module generally describes a device installed on a battery to provide varying levels of functionality depending on the module model. Some features of the Charger Interface software discussed in this manual may only apply to certain battery module types.

Unless otherwise stated, reference to a battery module is assumed to be the APC/BMID module.

APC/BMID Module

APC (Automatic Profile Configuration) Module and BMID (Battery Monitoring and Identification) provide identification to the charger of battery type and required charge profile as well as basic battery status including temperature, electrolyte level, and voltage imbalance monitoring.

BMM/BMID 'Current Sensing'

BMM (Battery Monitoring Module) provides the functionality of the APC/BMID module, as well as charge/discharge current monitoring and data logging features.

1.9. Software License for Battery Module Data Access

In order to retrieve the full range of BMM and Current Sensing BMID data, Charger Interface requires activation by the purchase of a software license. Purchase will result in supply of a license file. See below for instructions to activate the Charger Interface for BMM.

Charger Interface allows as standard access to the BMM Data Log. The addition of the Software License provides access to the following logs by enabling tabs dedicated to each:

BMM Alarm Log

BMM Charge Log

BMM Daily Log

See Section 2 for details and use of each of these tabs.

Activating the Battery Module License

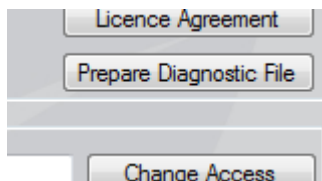
1. Click **Software Licensing** under the **About** menu.
2. Click **Import License File** and select the supplied license file.
 - ➔ A valid license file will display the licensing details, including Name, Company in the **Current License** area.

1.10. Diagnostics

Troubleshooting issues may be aided by saving a diagnostic file for review by an expert. The file contains the full configuration as read by Charger Interface and allows the charger configuration to be loaded and viewed on a separate PC.

Create Diagnostics File

1. Click the **About** option in the menu bar.
2. Click **Prepare Diagnostic File**.



- ➔ A prompt requests confirmation to include battery module data (if connected). Battery module data can take up to 1 hour to fully download. If the issue does not involve a battery module, click **No**.
- ➔ The diagnostic file is prepared and saved in the default Documents folder of the currently logged in user. The file name incorporates the charger serial and current date in an XML file.

2. Charger Interface Tabs

2.1. Tab Overview

Charger Interface displays the various charger data in a series of tabs within the main window. Tabs may be closed from view or reopened using the **Charger** and **Battery Module** menus in the main window title bar.

Depending on the user access level, some tabs may not be available.



Indicates a tab accessible only at the Advanced Access level.

Licensed

Indicates a tab available with additional Software License purchase.

Some tabs such as the Monitoring Tab are undocked by default. These tabs may be docked to the main window by double-clicking the tab title bar.

Charger Tabs

Charger Status

View recent charge cycles for insight into the health and usage of the battery. If the charger is used to charge multiple batteries, the battery ID can be selected. Also available on this tab is the ten most recent alarms recorded.

Configuration

View the current configuration of the charger, including battery type, equalise, scheduled start, and start delay options. Changing these options requires Configuration access.

Charge Log

Displays the charge cycle log for saving to PC. Useful for determining usage trends, battery health.

Alarm Log

Displays all recorded charger and battery alarms for analysis and saving to PC.

Monitoring

A live display of the current charge cycle parameters including battery, charger module and alarm status.

Charge Profiles

View and edit charge profiles for each battery and charge type.

Bootloader

Update the charger and battery module firmware.

Alarm Configuration

Configure or re-define alarms according to urgent/non-urgent status. On-board relays to activate according to specified alarm states.

Controller Settings

Advanced control of the charger low-level control functions, including setting service mode, temperature compensation, fast charge, auto water and battery module enable.

Battery Module Tabs

Battery Module Monitoring

Monitor battery status via a battery module.

Battery Module Configuration

Configure battery module for battery type and ratings as well as set charge profile types and sequences for a battery module.

Battery Module Settings

Additional module settings and functionality control.

BMM Alarm Log Licensed

View and save the alarm log from a BMM battery module.

BMM Charge Log Licensed

View and save the charge log from a BMM battery module.

BMM Data Log

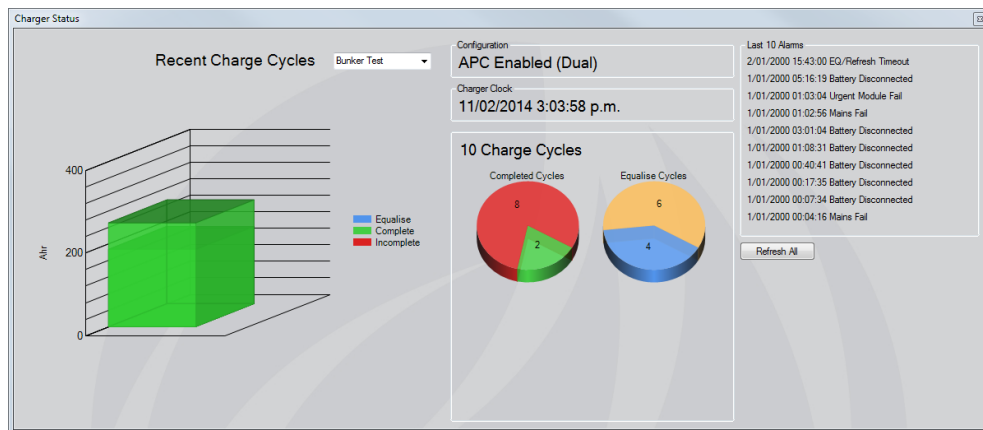
View and save the data log from a BMM battery module.

BMM Daily Log Licensed

View daily summaries of battery activity.

2.2. Charger Status Tab

Gain a quick overview of the most recent charge cycles, the charger configuration and recent alarms.



2.4. Configuration Tab

The Configuration tab allows the charger configuration to be viewed, modified and saved back to the charger.

The screenshot shows the 'Configuration' window with the following sections:

- Configuration Template:** 24V 300Ahr Flooded Conventional IUla, FS3, Three Phase 20A. Buttons: Use Values, Import CSV.
- Charger Configuration:** Nominal Voltage: 24 V, Start Current: 48 A (16A/100Ahr), Battery Rating: 300 Ah, Typical Battery Temperature: 30.0 °C, Typical Cable Temperature: 29.4 °C, Charge Profile: Flooded, Charger Cable Length: 2.4 m, Cable Cross-Sectional Area: 50 mm². Buttons: Read Configuration, Write Configuration, Save Configuration To File, Configure From File, Verify Configuration.
- Battery Type:** 24V 300Ahr Flooded Conventional IUla. Fields: DC Plug: SB175, Module Type: MP130, Number Of Modules: 2, AC Voltage: 240V, Maximum AC Current Per Phase: 6.9A, Number Of Phases: Single Phase, Part Number: FS3-LNE-512-S, Weight: 18.3kg, Finishing Current: 14A, Special Instructions: Print Label.
- Auto Equalise Settings:** Set by Profile, Cycle based, Time based. Set Time: 5:00 pm, Day of Week: Saturday, Week Frequency: 1.
- Auto Watering Settings:** Enabled, Duration: 10 s, Frequency: 1 Cycles.
- Daily Charging Schedule:** Enabled. Visual bar chart showing charging (green) and no-go (red) periods: 12am-4am (red), 4am-8am (green), 8am-12pm (green), 12pm-4pm (green), 4pm-8pm (red), 8pm-11:59pm (red).
- Start Time Delay:** Enabled, Time Delay: 0:00 (Hours:Minutes).
- Cool Down Period:** Enabled, Time Delay: 0:00 (Hours:Minutes).
- Real Time Clock:** 20/12/2013 7:46:46 a.m. Buttons: Read, Set to Computer Time.

Uses:

View or edit charger configuration depending on access level.

Print charger rating label using configuration parameters.

Configure Auto Equalise, Daily Charging Schedule, Start Time Delay, Cool Down Timer. Set charger internal clock.

Section Overview:

Configuration Template

Select battery, charger model and AC supply type to generate the charger configuration automatically. A CSV file with the appropriate parameters must first be loaded using the **Import CSV** button.

Charger Configuration

View the current configuration of the charger, print a rating label. Changing these options requires Configuration access.

Print Label

Print a rating label once the charger is configured. Options for what parameters to print and print designation are available.

Auto Equalise Settings

Set the charger to perform equalise charges according to defined rules: profile, cycle or time based. Requires Configuration access.

Auto Watering Settings

Set duration and number of charge cycles per watering event. Auto Water activation is via Relay 2 by default.

Daily Charging Schedule

Daily lockout periods can be set by dragging three bars horizontally. Green and red sections indicate go and no-go periods respectively.

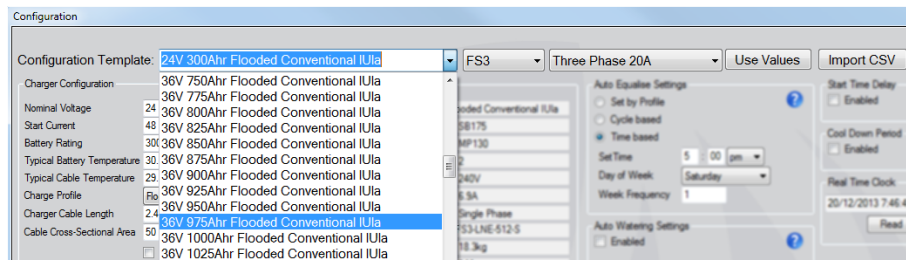
Start Time Delay

Set a delay in hours:minutes to delay charging after the charger switch is set to Start. Charger displays a count-down timer to charge.

Real-Time Clock

Read or set the charger's internal clock. An internal cell battery maintains the RTC in the event of a power outage.

2.4.2. Configuration Template



Configuration templates simplify charger configuration and allow for accurate configurations with minimal user input. The templates are pre-set configurations that may be selected for certain battery types. A template may be used as-is (Configuration Access) or loaded

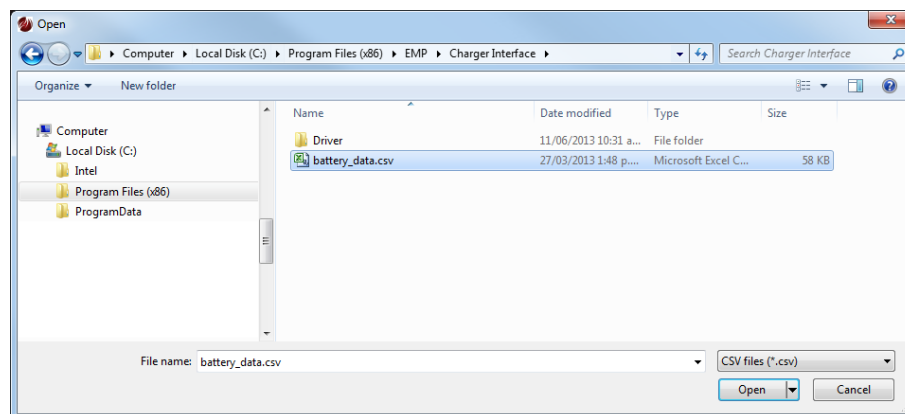
and details fine tuned (Advanced Access required to adjust parameters).

Template data is contained in a CSV formatted file that needs to be imported into Charger Interface when using a template for the first time.

2.4.3. Import CSV

Charger Interface software packages ship with a Configuration Template CSV file included. The CSV file contains the ratings and related charge configuration data for known battery types.

To import a CSV, click Import CSV and locate the CSV file. Typically a dealer-supplied CSV file is located in the Charger Interface installation folder within the Program Files folder.



2.4.4. Charger Configuration

The Charger Configuration section displays the set parameters for a charger configured for a single battery type. See Section 3: Charger Configuration for a description of the various charger/battery module configuration options, and step-by-step example configurations.

The Charger Configuration section displays the fundamental charge parameters of the charger as determined by the battery it is configured for. Modifying these parameters requires Advanced

Access.

- ➔ Click **Read Configuration** to retrieve current values from the charger.
- ➔ Always click **Write Configuration** to save these settings to the charger. Failure to do so will leave the charger with the previous settings.

Nominal Voltage

As defined by the battery, typically 24V/36V/48V

Start Current

Defines the maximum current delivered in the first stage of the charge, as recommended by the battery manufacturer.

Battery Rating

Capacity of the battery, measured by discharge rate x discharge time. Typical motive batteries are measured at a 5 hour ("C5") rate, e.g. a 500Ah battery can be discharged for 5 hours at 100A.

Typical Battery Temperature

An indicative value of the battery temperature that assists in managing parameters during a charge.

Typical Cable Temperature

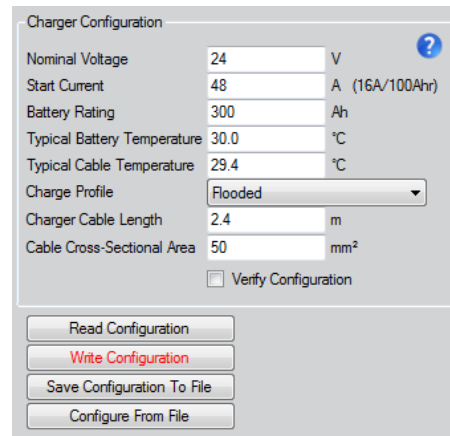
An indicative value of the battery cable temperature that assists in managing parameters during a charge.

Charge Profile

Profile as selected according to the battery type and requirements. Profiles are defined in the Charge Profiles tab.

Charger Cable Length

Length of cable from charger to battery. An indicative value used to

A screenshot of a 'Charger Configuration' dialog box. It contains several input fields: 'Nominal Voltage' (24 V), 'Start Current' (48 A (16A/100Ahr)), 'Battery Rating' (300 Ah), 'Typical Battery Temperature' (30.0 °C), 'Typical Cable Temperature' (29.4 °C), 'Charge Profile' (Flooded), 'Charger Cable Length' (2.4 m), and 'Cable Cross-Sectional Area' (50 mm²). There is a 'Verify Configuration' checkbox which is unchecked. At the bottom, there are four buttons: 'Read Configuration', 'Write Configuration', 'Save Configuration To File', and 'Configure From File'.

manage parameters while charging.

Cable Cross-Sectional Area

Gauge of cable from charger to battery. An indicative value used to manage parameters while charging.

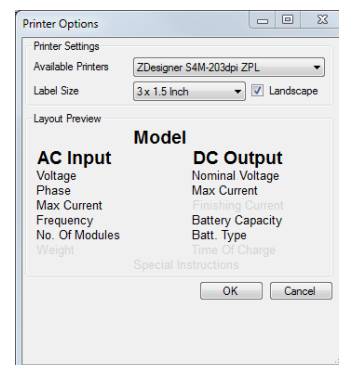
Verify Configuration

When enabled during **Write Configuration** the charger checks that the installed modules can meet the requirements of the chosen configuration.

Should the required configuration exceed the capacity of the installed modules, install further modules or a larger capacity charger is required.

2.4.5. Print Label

Label printing options include printer selection, label size and orientation selections. A layout preview allows selection or removal of fields from the resulting printout. A grey field indicates a field that will not be printed.

A screenshot of a 'Printer Options' dialog box. It has a 'Printer Settings' section with 'Available Printers' set to 'ZDesigner S4M-203dpi ZPL' and 'Label Size' set to '3 x 1.5 inch'. There is a 'Layout Preview' section with a 'Model' header. Under 'Model', there are two columns: 'AC Input' and 'DC Output'. 'AC Input' includes fields for Voltage, Phase, Max Current, Frequency, No. Of Modules, and Weight. 'DC Output' includes fields for Nominal Voltage, Max Current, Finishing Current, Battery Capacity, Batt. Type, and Time Of Charge. There is a 'Special Instructions' field at the bottom. 'OK' and 'Cancel' buttons are at the bottom right.

2.4.7. Auto Equalise

An automatic equalise charge can be programmed to begin automatically according to defined parameters: Profile, Cycle or Time based.

Set By Profile

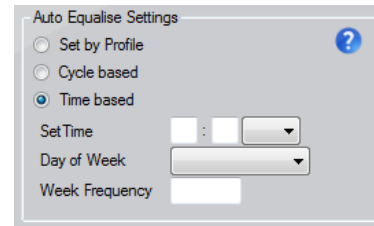
Any equalise settings are controlled within the set charge profile, configurable in the Charge Profile tab. See Section 2.11.

Cycle Based

Cycle based equalise parameters apply to a charger configured with a dedicated profile, as the number of charge cycles that charger performs.

A charger set as APC Enabled uses the battery module charge cycle count to determine a battery's need for an equalise charge.

Time based



The equalise charge can be set to occur at a specific time, weekday and at a week-based interval.

2.4.8. Auto Watering Configuration

Auto watering functions are triggered primarily by a charge cycle frequency count configured on the **Configuration** tab.

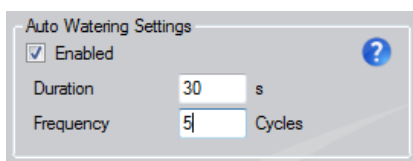
If a battery module is installed with an electrolyte sensor, the module can be configured to monitor

electrolyte levels, triggering an auto watering cycle if required.

See your auto watering kit installation manual for full hardware and software configuration.

Auto Water Activation

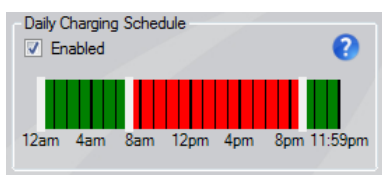
1. Connect to the charger and select the **Configuration** tab.
2. Check the **Auto Watering Enable** option and enter the required values for **Duration** and **Frequency** and click **Write** to program the settings into the charger.



- **Duration** (seconds) determines the length of time the auto watering circuit is open and providing water to the battery.
- **Frequency** (cycles) determines the number of charge cycles per watering activation.

2.4.9. Daily Charging Schedule

The charging schedule provides a graphical representation of a 24 hour period, with markers at 1 and 4 hour intervals.



Dragging the three white vertical bars allows setting of lockout periods (red) preventing charging. This is useful where power providers offer discounted power pricing during off-peak demand periods.

- If a battery is connected and the start/stop switch activated during a lockout period, a Start Time Delay counter on the charger display will count

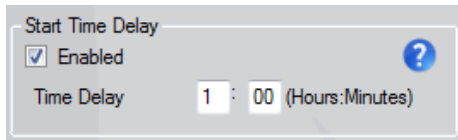
down to the charge start.

- If a charge is interrupted by a lockout period, the Daily Schedule Stop alarm is

flagged and the charge will resume at the end of the lockout period.

2.4.10. Start Time Delay

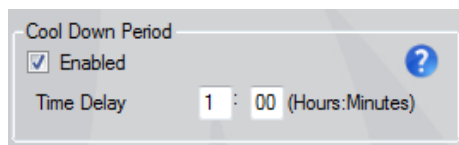
A start time delay may be set in hours:minutes to start the charge after the specified delay.



- A start delay is typically used to allow heavily used batteries to cool before charging begins.
- The charger Start/Stop switch must be activated to begin the delay timer.
- A user may over-ride the Start Time Delay by holding the Enter button on the front panel for approximately 10 seconds. The delayed charge will begin immediately.

2.4.11. Cool Down Period

A period following a charge may be set to allow the battery to cool before the charger indicates charge completion.



- If enabled, the cool down period begins at the end of the charge, with the charger display counting down the specified cool down time in Hours:Minutes. The front panel green LED alternates on/off during this period.
- When the cool down period is complete, the green LED remains steady on, and the charger display counter indicates the total time the battery has cooled.

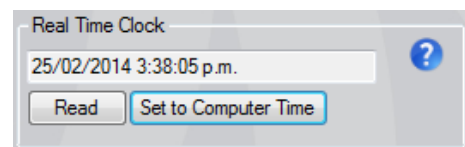
2.4.12. Real Time Clock

The charger's internal clock allows charge and alarm logs to accurately timestamp records as well as the Daily Charging Schedule and other features to perform as required.

It is important that the Real Time Clock is accurately set for the local time zone.

The date format is dd/MM/yyyy

The time format is hh:mm:ss



- Ensure the connected PC has the correct local time and click **Set To Computer Time**.
- Click **Read** to confirm the charger's clock is now set accurately.
- The real time clock will display in 12hr format regardless of the PC's 12/24hr setting.

2.6. Charge Log Tab

The Charge Log tab displays a number of details for each charge cycle for analysis and troubleshooting. Records can be viewed in the tab by clicking **Read**, and downloaded to a PC in CSV or XML formats using the **Save** button. **Erase** will clear all records currently stored on the charger.

Each charge cycle is recorded with profile type, durations of the various charge phases, start and

finishing voltages, as well as charge returned.

Charge logs are retained in the charger memory by an internal battery and are not subject to erasure due to power loss.

When the 2400 charge cycle record maximum is reached, the charger retains only the most recent records. Logs should be retrieved from the charger regularly to maintain charge cycle records.

Charge Log

| Number of Starts | | 10 | Full Cycles | | 2 | Partial Cycles | | 8 | EQ/Refresh Cycles | | 4 | Auto Water Cycles | | 0 | <div><div>Read</div><div>Save</div><div>Erase</div><div>?</div></div> | | | | |
|------------------|----------------|----------------------|-----------------|-----------------|------------------|----------------|---------------------|------------------|-----------------------|------------------------|------------------------|-------------------|-------------------|----------------------|---|-------------------|-------------------|------------------------|------------------------|
| Record Number | Charger Number | Date/Time | Nominal Voltage | Maximum Current | Battery Capacity | Profile Used | Battery Charge Time | Bulk Charge Time | Finishing Charge Time | Eq/Refresh Charge Time | Battery Connected Time | Starting Voltage | Finishing Voltage | Starting Temperature | Finishing Temperature | Finishing Current | Capacity Returned | Terminated By | Battery Identification |
| 1 | 10 | 2/01/2000 8:39 a.m. | 48 | 135 | 550 | Opportunity | 01:52:00 | 01:52:00 | 00:00:00 | 00:00:00 | 05:52:01 | 1.969 | 2.374 | 28.4 | 33.4 | 135.1 | 251 | Bulk Charge Stage Only | Bunker Test |
| 2 | 9 | 2/01/2000 12:15 a.m. | 48 | 135 | 550 | Opportunity | 01:23:34 | 01:23:34 | 00:00:00 | 00:00:00 | 01:27:49 | 2.004 | 2.382 | 27.3 | 30.8 | 134.9 | 187 | Bulk Charge Stage Only | Bunker Test |
| 3 | 8 | 1/01/2000 8:05 p.m. | 48 | 90 | 550 | Flooded | 04:04:31 | 00:00:53 | 04:03:38 | 00:00:00 | 19:54:06 | 2.106 | 2.400 | --- | --- | 27.0 | 227 | Battery Disconnected | |
| 4 | 7 | 1/01/2000 4:00 a.m. | 48 | 90 | 550 | Flooded | 00:18:20 | 00:00:18 | 00:18:01 | 00:00:01 | 01:17:43 | 2.345 | 2.657 | --- | --- | 26.9 | 8 | Battery Disconnected | |
| 5 | 6 | 1/01/2000 2:42 a.m. | 48 | 90 | 550 | Flooded | 01:22:34 | 00:00:19 | 02:33:01 | 00:59:14 | 01:28:35 | 2.232 | 2.562 | --- | --- | 25.0 | 35 | Main Switch | |
| 6 | 5 | 1/01/2000 1:14 a.m. | 48 | 90 | 550 | Flooded | 02:24:21 | 00:00:19 | 02:40:01 | 00:00:01 | 02:29:51 | 2.243 | 2.557 | --- | --- | 26.8 | 10 | Battery Disconnected | |
| 7 | 4 | 1/01/2000 12:43 a.m. | 48 | 90 | 550 | Flooded | 01:16:00 | 00:00:21 | 01:17:39 | 00:00:00 | 00:21:14 | 2.192 | 2.468 | --- | --- | 27.3 | 8 | Battery Disconnected | |
| 8 | 3 | 1/01/2000 12:22 a.m. | 48 | 90 | 550 | Flooded | 00:02:55 | 00:00:21 | 00:02:34 | 00:00:00 | 00:07:59 | 2.173 | 2.465 | --- | --- | 21.6 | 1 | Battery Disconnected | |
| 9 | 2 | 1/01/2000 12:14 a.m. | 48 | 90 | 550 | Flooded | 00:03:07 | 00:00:33 | 00:02:34 | 00:00:00 | 00:10:10 | 2.125 | 2.411 | --- | --- | 23.5 | 1 | Battery Disconnected | |
| 10 | 1 | 1/01/2000 12:04 a.m. | 48 | 90 | 550 | Flooded | 00:00:01 | 00:00:01 | 00:00:00 | 00:00:00 | 00:00:01 | 2.125 | 2.125 | --- | --- | 0.0 | 0 | Main Switch | |

2.7. Alarm Log Tab

The Alarm Log tab displays the last 200 alarms recorded during the operation of the charger. Records can be viewed in the tab by clicking **Read** and downloaded to a PC in CSV or XML formats using the

Save button. **Erase** will clear all records currently stored on the charger.

Refer to Section 6: Alarms for charger alarm definitions.

| Alarm Log | | | | | |
|---------------|----------------------|-------------------------|-------------------|-----------------|------|
| Record Number | Date/Time | Blink Charge Stage Only | EOR/Fresh Timeout | Minimum Current | -dHt |
| 1 | 2/01/2000 3:43 p.m. | | | | |
| 2 | 1/01/2000 8:05 p.m. | | | | |
| 3 | 1/01/2000 5:16 a.m. | | | | |
| 4 | 1/01/2000 1:03 a.m. | | | | |
| 5 | 1/01/2000 1:03 a.m. | | | | |
| 6 | 1/01/2000 1:03 a.m. | | | | |
| 7 | 1/01/2000 1:02 a.m. | | | | |
| 8 | 1/01/2000 4:00 a.m. | | | | |
| 9 | 1/01/2000 3:01 a.m. | | | | |
| 10 | 1/01/2000 1:14 a.m. | | | | |
| 11 | 1/01/2000 1:08 a.m. | | | | |
| 12 | 1/01/2000 12:43 a.m. | | | | |

2.9. Monitoring Tab

The monitoring tab provides real-time updates on the parameters of the charge, charger alarm states and per-module status indicators

for the charge in progress. Detailed logging directly to the file on the connected PC is available.

Sections

Charge Status

View current charge parameters as delivered to the battery and elapsed times. Charge parameters reflect all variables entered into the **Configuration** tab including cable and battery variables.

Alarms

Real-time view of alarm states – green indicates clear state, red indicates alarm state is currently triggered.

Charger Modules

Click on a module label to view individual module reports displaying current, input and output air temperatures per charger module. Green indicates charging state, red indicates alarm or failure, grey indicates module deactivated or not in use.

Charge Detail Log

The **Start Logging** button initiates collection of detailed charging data directly to a connected PC. Sample rate, log filename and location and log start time can be customised.

The screenshot displays the 'Monitoring - 80V 575Ahr Flooded' window. It is divided into several sections:

- Charge Status:** A table showing parameters like Battery Voltage (70.44 V), Voltage Per Cell (1.761 V), Battery Current (1.3 A), Charge Returned (0 Ahr), Battery Temperature (--- °C), and Charge State (SERVICE MODE). It also shows elapsed times for Connected, Bulk, Finishing, EQ/Refresh, and Total charge.
- Cell and Cable Data:** A table with Cell Voltage dV/dt (--- mV/15mins), Cable Resistance (2.4 mΩ), Temp Comp Voltage (-0.015 V), Demand Voltage (70.00 V), Demand Current (0.5 A), and Fuse Voltage (-0.02 V).
- Alarms:** A grid of 16 items, each with a status (green for clear, red for active) and a description. Active alarms include 'Main Switch', 'Inlet Filter', 'Low Mains', 'Mains Fail', 'Over Discharged Battery', 'Deeply Discharged', 'Sulphated Battery', and 'Incorrect Battery'.
- Modules:** A section showing three modules (Module 1, 2, 3) with their respective serial numbers, output currents (all 0.0A), and temperatures. Below this is a 'Start Logging' button.

2.11. Charge Profiles Tab

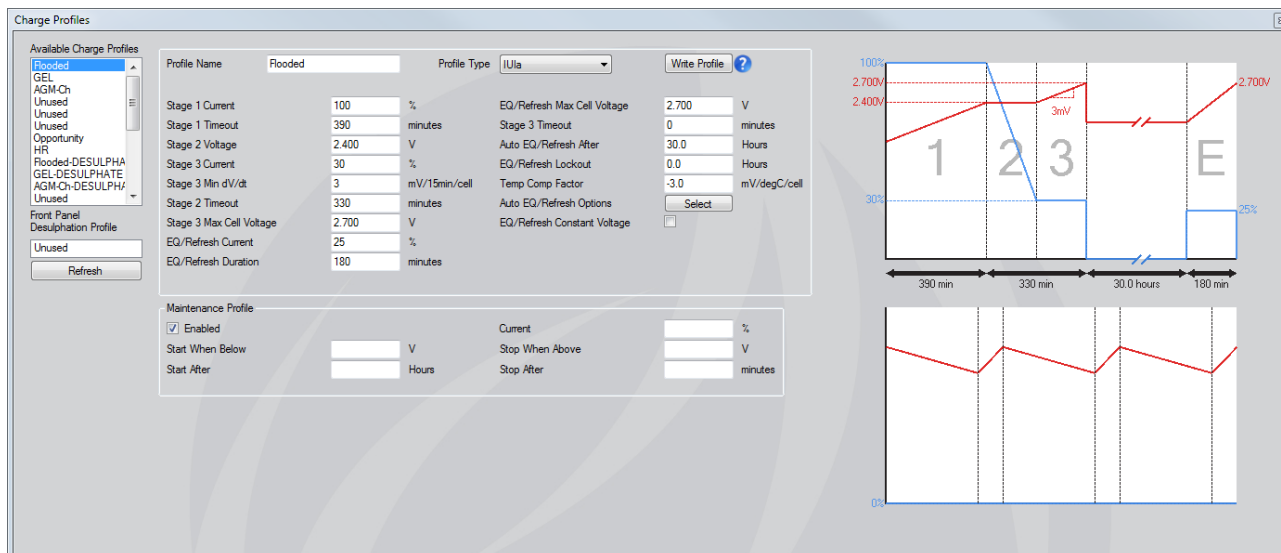
The charge profile used during charging is selected in the **Configuration** tab, (if using a battery module, the charge profile is selected in the **Battery Module Configuration** tab), however the **Charge Profiles** tab is used to adjust the thresholds that define a profile and to create all new profiles.

The charger is programmed with eight default charge profiles

covering the most common battery chemistries and can store up to 16 additional customized charge profiles.

Each stage of the charge cycle has thresholds, timeouts and durations which may be adjusted to suit specific batteries and charge rates.

A graphical representation of the profile is provided reflecting the threshold values.



Profile Type

The **Profile Type** drop-down list allows the basic structure of the profile to be selected. Descriptions of available profile types are listed below.

| | "Bulk" | | "Finishing" | | |
|--------------|---|------------------|------------------|---|--|
| Profile Type | Stage 1 | Stage 2 | Stage 3 | Description | |
| Unused | A profile configured as Unused allows that profile to be rendered non-functional and is ignored by the charger. | | | | |
| IUIa | Constant Current | Constant Voltage | Constant Current | Standard three stage charge profile for flooded cells. | |
| Ia | Constant Current | | | Useful for commissioning or de-sulphating batteries. Normal charger min/max voltage operation parameters apply. | |
| IUUa | Constant Current | Constant Voltage | Constant Voltage | Useful for infrequent charging of AGM traction batteries. | |
| IUa | Constant Current | Constant Voltage | | Charging reserve batteries or using as a power supply. | |

Auto Equalise/Refresh Options

Equalise charges may be configured as a part of a profile. See Auto Equalise/Refresh in Section 3.3.

Dual profile operation is enabled by configuring a Primary Profile as either:

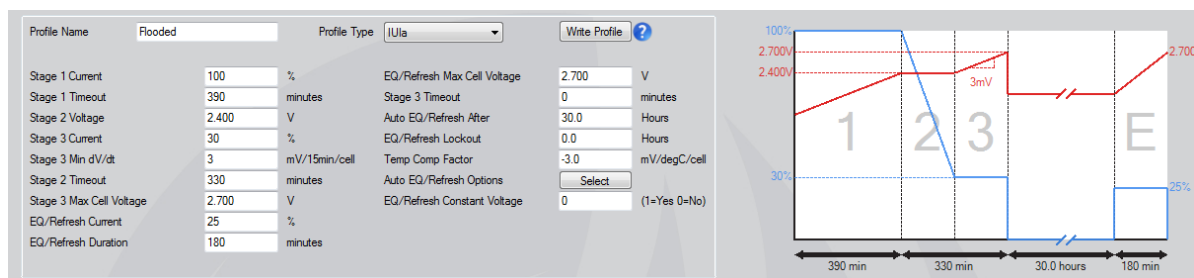
Bulk Charge Only, Full Charge on Equalise

Or

Bulk Charge Only, Full Charge after Delay

Profile Management

Details of a profile may be viewed or changed by selecting the desired profile from the list of available charge profiles. Thresholds and values for each stage is shown, alongside a graphical representation of the charge profile.

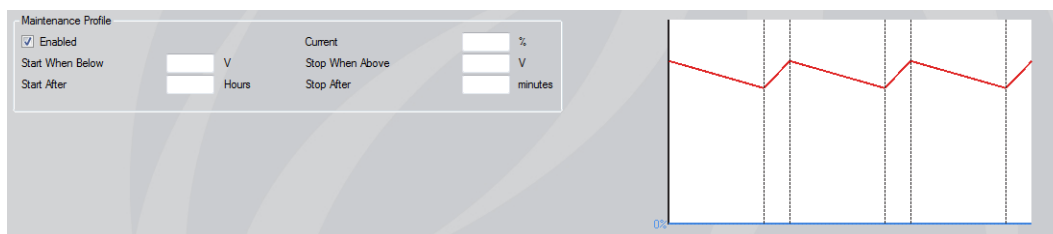


Maintenance Profile

Engaging the Maintenance Profile provides a cycle of top-up charging to take place following completion of any charge profiles, and until the charger is switched off or the battery is disconnected.

The maintenance profile manages the battery based on voltage and time thresholds.

Any desired changes must be saved to the charger using the **Write Profile** button.



Front Panel Desulphation Profile (V52 firmware and later)

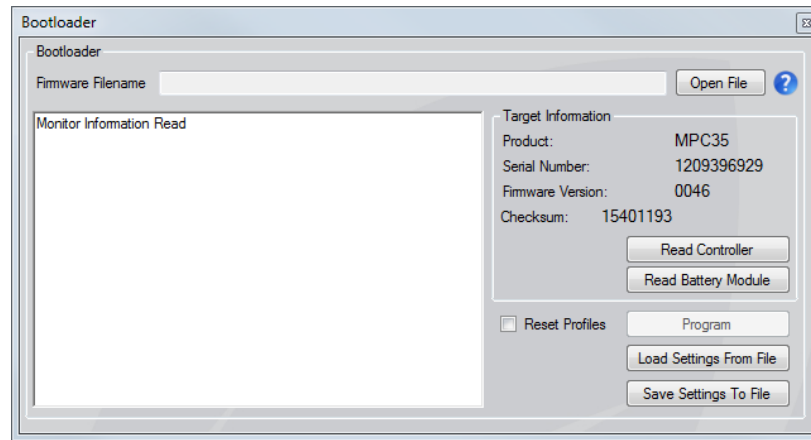
This feature allows designation of a profile for access and selection via the Service Menu on the charger front panel. Typically used for a one-off desulphation charge, the charger will return to the standard profile once complete.

1. To configure, select the listed profile under **Front Panel Desulphation Profile**.
2. Enter the profile details in the Profile Management area. Profile Type is required to be set for the profile to be valid for use.
 - The profile may be configured as any other profile and may be configured for desulphation by default, depending on the charger's factory configuration.
3. Click **Write Profile** to save the details into the Front Panel Desulphation Profile location.
 - The profile may be enabled at the charger front panel by holding both up and down buttons for 16 seconds to enter the Service Menu, and using the up or down button to select the Desulphation option. Use the OK and up/down buttons to enable then store the change. The profile will take affect for the next charge only.

2.12. Bootloader Tab

The **Bootloader** tab may be used to update the embedded firmware in both the charger and battery module.

See Section 5: Firmware Bootloading for more information.



2.13. Alarm Configuration Tab

Requires Advanced Access.

The various charger alarms are, by default, organised into **Urgent** and **Non-Urgent** levels. The level of the alarm determines the charger's response to that alarm. In addition to alarm levels, alarms can also be configured to activate one of two relays, or activate the in-charger audible beep.

Read/Write

Click **Read** to view each of the lists stored in the charger, **Write** to save any changes to a list back to the charger.

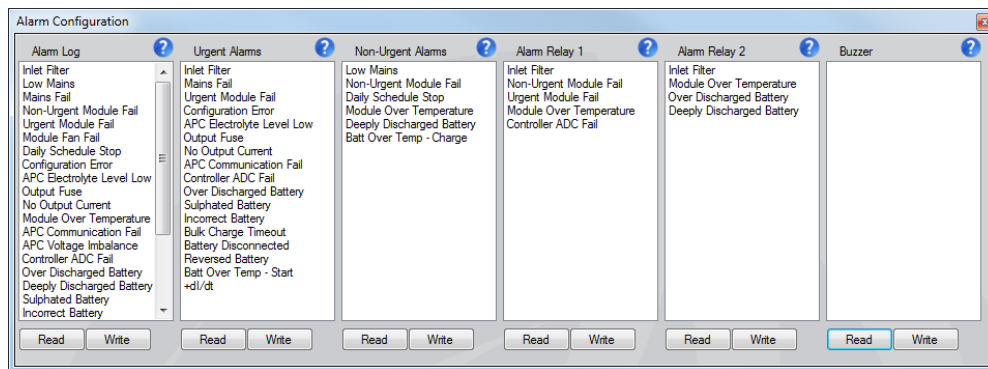
Lists

Six lists allow addition and removal of alarms from each category as labelled at the top of each list.

Right-clicking in a list allows a new alarm to be added to that list.

Right-clicking on a selected alarm in a list allows the option to remove that alarm from the list.

Refer to Section 6: Alarms for a list of the default alarm lists.



Alarm Configuration Lists:

Alarm Log

Alarms listed here will appear in the alarm log.

Urgent Alarm

Alarms categorized as Urgent terminate the charge cycle and alarm and charge logs are flagged with the event. Notification is by a front panel display message and alternate flashing Ready and Charging LEDs.

Non-Urgent Alarm

Alarms categorized as Non-Urgent allow the charge cycle to continue. Flags alarm log. Notification is by front panel display and flashing red Charging LED.

Alarm Relays 1 & 2

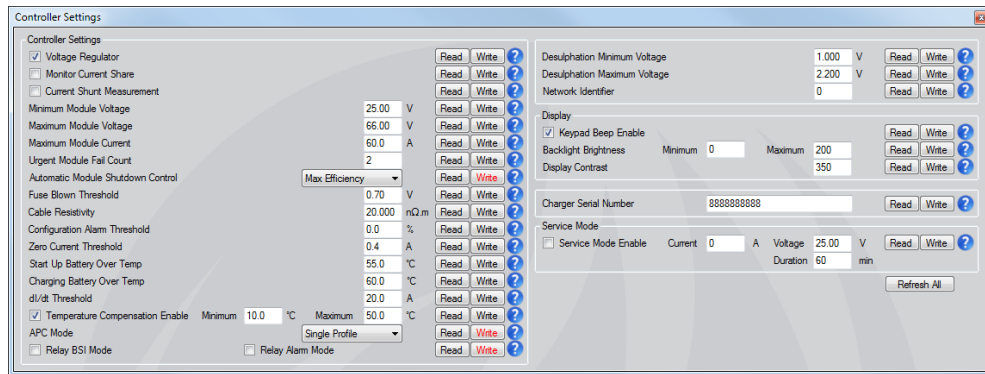
Alarms selected to activate an on-board relay for external accessories.

Buzzer

Alarms selected to produce an audible tone from the charger when triggered, until the alarm condition is cleared or the charge cycle is complete.

2.15. Controller Settings Tab

Provides full control over advanced charger settings and parameters.



Settings:

Voltage Regulation

Regulate voltage at charger level instead of module level. Default: Enabled

Monitor Current Share

Regulate current at charger level instead of module level. Default: Enabled.

Current Shunt Measurement

Measure current output using FS5 & 9 charger shunt(s). Default: Enabled

Minimum Module Voltage

Minimum nominal voltage the charger can be set to. Default: 25V

Maximum Module Voltage

Maximum nominal voltage charger can be configured to. Default: 66V

Maximum Module Current

Maximum current per charger module. Default: 66V

Urgent Module Fail Count

Number of failed modules required before an urgent alarm is triggered, stopping the current charge cycle. Default: 2

Automatic Module Shutdown

Intelligently disable modules to ensure charger operates at the highest efficiency or to optimise power factor.

Fuse Blown Threshold

Maximum Voltage allowed across the DC fuses before the output fuse alarm is set Default: 0.7V

Cable Resistivity

DC cable resistance value. Default: 20nΩ.m

Configuration Alarm Threshold

Percentage of nominal current that must be achieved by the charger within a given time, before the charger triggers the configuration error alarm. Default: 95%

Zero Current Threshold

Minimum amount of current possible before an urgent alarm is triggered and charge terminated. Default: 0.4A

Start-up Battery Temp Limit

Charger will not start if this value is exceeded at start-up. Default: 55°C/131°F

Charging Battery Temp Limit

Charger will trigger an urgent alarm and terminate charge if this value is exceeded. Default: 60°C/131°F

dI/dt Threshold

Maximum allowable increase in current during the finishing charge. Default: 20A

Temperature Compensation

Temperature compensation when an external temp sensor or battery module is fitted. Default: Disabled

APC Mode/BMID Mode

Force charger into APC mode: Single, Dual or Disabled. Default: Disabled

Battery Status Indicator

Dedicate two relays to triggering a remote charge status indicator (relays 1&3).

Relay Alarm Mode

Dedicate two relays to an alarm trigger. Specify the alarm type and relay in the Alarm Configuration tab.

Desulphation Minimum Voltage

Specify minimum voltage limit during desulphation charge.

Desulphation Maximum Voltage

Specify maximum voltage limit during desulphation charge.

Network Identifier

Optional unique identifier for large networked charger installations.

Keypad Beep

Enable or disable audible feedback on front panel buttons.

Backlight Brightness

Set minimum and maximum values for LCD backlight. Default Min:0, Default Max: 255

Display Contrast

Adjust readability of LCD. Default: 350

Charger Serial Number

Read or change the serial number of the charger.

Service Mode

Allows manual specification of charge parameters. Charger operation is possible at a defined voltage, current and duration.

CAUTION: Normal charger self-protection features are disabled in this mode.

Refresh All

Read all visible values from the charger.

2.16. Battery Module Monitoring Tab

View real-time and accumulated data from a connected battery module. Availability of battery current data depends on the model of battery module.



Status

Critical, real-time battery data.

Active Alarms

Alarms reported by the module as currently active.

Counters

Battery charge, discharge and other battery condition data as accumulated by the battery module.

- ➔ Right-click on the Counters section to adjust the reporting parameters.

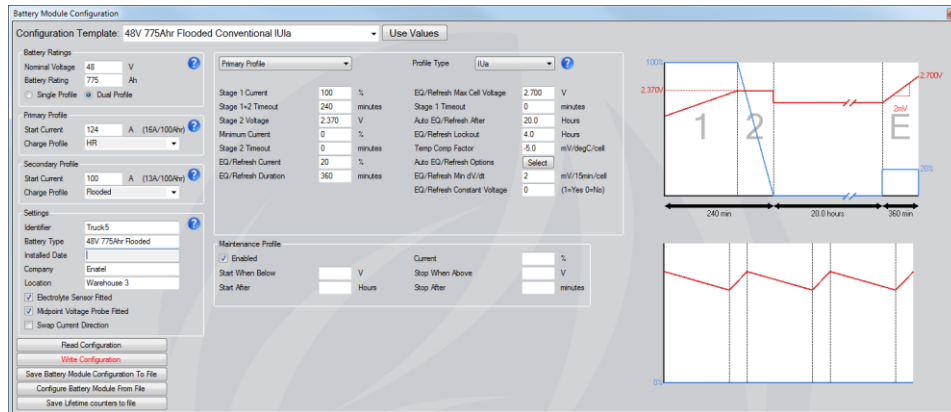
2.18. Battery Module Configuration Tab

Use the Battery Module Configuration Tab to read the battery module configuration or configure a new battery module.

The Configuration Template simplifies configuration by choosing a predefined configuration appropriate for the battery type.

First time use of the template option requires a template file to be loaded using Import CSV button on the Configuration Tab.

Modifying individual configuration values and other settings requires **Advanced Access**.



Battery Ratings

Parameters from the battery rating plate, Single or Dual Profile selection.

Dual Profile operation allows two distinct profiles to be stored in the battery module. Chargers may be configured to use the Primary, Secondary or both profiles in sequence.

Primary/Secondary Profile

Set start current and basic profile type for the Primary Profile and if utilising Dual Profiles, the Secondary Profile. The A/100Ahr rate for the start current value is shown.

Settings

Set a module identifier for quick reference in logs and other data.

Installed Date is populated automatically based on the PC's clock.

Other optional battery module configurations may be set depending on the installation. Swap Current Direction may be used where a BMM is reporting reversed current flow.

Save/Configure Battery Module to/from File

See Section 4.3 for battery module backup operations.

Save Lifetime Counters to File

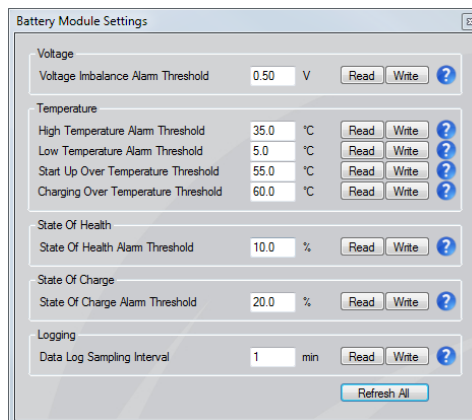
Save a summary of battery lifetime status counters to CSV file.

This screenshot shows a detailed view of the 'Battery Ratings' and 'Settings' sections. The 'Battery Ratings' section includes 'Nominal Voltage' (48 V), 'Battery Rating' (550 Ah), and radio buttons for 'Single Profile' and 'Dual Profile'. The 'Primary Profile' section shows 'Start Current' (135 A (25A/100Ahr)) and 'Charge Profile' (Opportunity). The 'Secondary Profile' section shows 'Start Current' (90 A (16A/100Ahr)) and 'Charge Profile' (Flooded). The 'Settings' section includes fields for 'Identifier' (Module2), 'Battery Type' (Flooded Lead Acid), 'Installed Date', 'Company' (Enatel), and 'Location' (Warehouse2). There are checkboxes for 'Electrolyte Sensor Fitted', 'Midpoint Voltage Sensor Fitted', and 'Swap Current Direction'. At the bottom, there are buttons for 'Read Configuration', 'Write Configuration', 'Save Battery Module Configuration To File', 'Configure Battery Module From File', and 'Save Lifetime counters to file'.

2.19. Battery Module Settings

Some battery module alarms trigger at predefined thresholds.

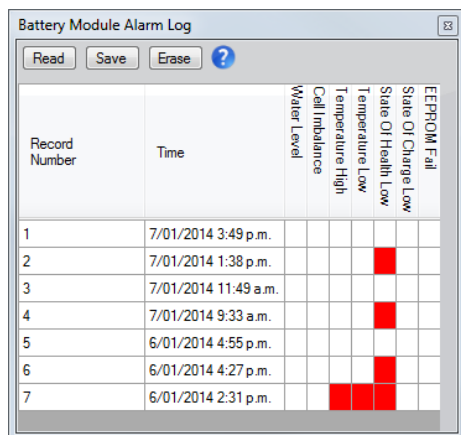
Setting thresholds involves adjusting the value and clicking **Write**.



| Voltage | |
|-------------------------------------|---------|
| Voltage Imbalance Alarm Threshold | 0.50 V |
| Temperature | |
| High Temperature Alarm Threshold | 35.0 °C |
| Low Temperature Alarm Threshold | 5.0 °C |
| Start Up Over Temperature Threshold | 55.0 °C |
| Charging Over Temperature Threshold | 60.0 °C |
| State Of Health | |
| State Of Health Alarm Threshold | 10.0 % |
| State Of Charge | |
| State Of Charge Alarm Threshold | 20.0 % |
| Logging | |
| Data Log Sampling Interval | 1 min |

2.20. BMM Alarm Log

A BMM can store more than 8000 alarm occurrences. These can be read and saved to file (CSV or XML), or erased from the module.

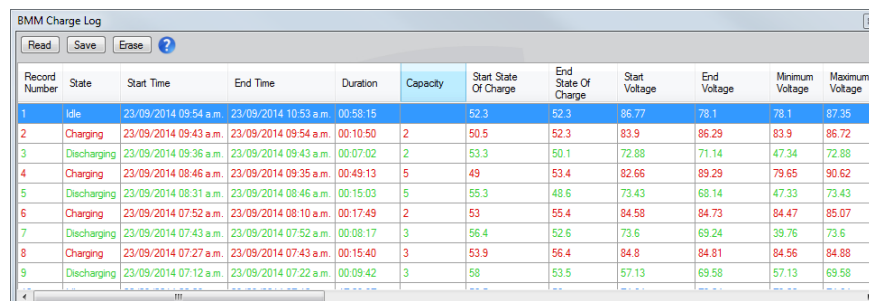


| Record Number | Time | Water Level | Cell Imbalance | Temperature High | Temperature Low | State Of Health Low | State Of Charge Low | EEPROM Fail |
|---------------|----------------------|-------------|----------------|------------------|-----------------|---------------------|---------------------|-------------|
| 1 | 7/01/2014 3:49 p.m. | | | | | | | |
| 2 | 7/01/2014 1:38 p.m. | | | | | | | |
| 3 | 7/01/2014 11:49 a.m. | | | | | | | |
| 4 | 7/01/2014 9:33 a.m. | | | | | | | |
| 5 | 6/01/2014 4:55 p.m. | | | | | | | |
| 6 | 6/01/2014 4:27 p.m. | | | | | | | |
| 7 | 6/01/2014 2:31 p.m. | | | | | | | |

→ If the maximum number of entries is reached, the log will purge the oldest entries first to allowing the most recent entries to be recorded.

2.21. BMM Charge Log

A BMM can store more than 4000 charge log entries. These can be read and saved to file (CSV or XML) or erased from the module.



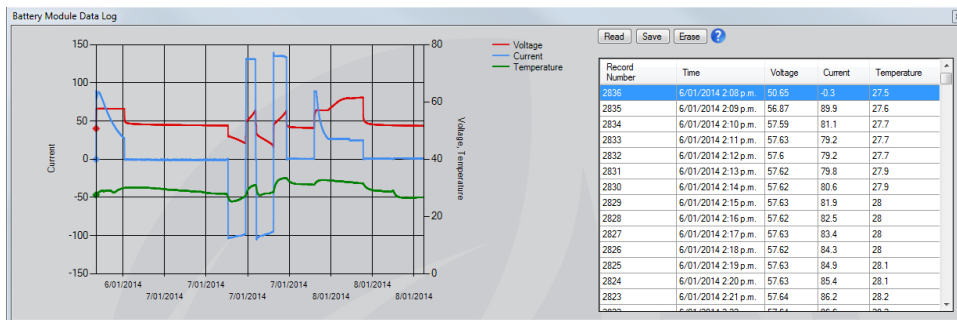
| Record Number | State | Start Time | End Time | Duration | Capacity | Start State Of Charge | End State Of Charge | Start Voltage | End Voltage | Minimum Voltage | Maximum Voltage |
|---------------|-------------|-----------------------|-----------------------|----------|----------|-----------------------|---------------------|---------------|-------------|-----------------|-----------------|
| 1 | Idle | 23/09/2014 09:54 a.m. | 23/09/2014 10:53 a.m. | 00:58:15 | | 52.3 | 52.3 | 86.77 | 78.1 | 78.1 | 87.35 |
| 2 | Charging | 23/09/2014 09:43 a.m. | 23/09/2014 09:54 a.m. | 00:10:50 | 2 | 50.5 | 52.3 | 83.9 | 86.29 | 83.9 | 86.72 |
| 3 | Discharging | 23/09/2014 09:36 a.m. | 23/09/2014 09:43 a.m. | 00:07:02 | 2 | 53.3 | 50.1 | 72.88 | 71.14 | 47.34 | 72.88 |
| 4 | Charging | 23/09/2014 08:46 a.m. | 23/09/2014 09:35 a.m. | 00:49:13 | 5 | 49 | 53.4 | 82.66 | 89.29 | 79.65 | 90.62 |
| 5 | Discharging | 23/09/2014 08:31 a.m. | 23/09/2014 08:46 a.m. | 00:15:03 | 5 | 55.3 | 48.6 | 73.43 | 68.14 | 47.33 | 73.43 |
| 6 | Charging | 23/09/2014 07:52 a.m. | 23/09/2014 08:10 a.m. | 00:17:49 | 2 | 53 | 55.4 | 84.58 | 84.73 | 84.47 | 85.07 |
| 7 | Discharging | 23/09/2014 07:43 a.m. | 23/09/2014 07:52 a.m. | 00:08:17 | 3 | 56.4 | 52.6 | 73.6 | 69.24 | 39.76 | 73.6 |
| 8 | Charging | 23/09/2014 07:27 a.m. | 23/09/2014 07:43 a.m. | 00:15:40 | 3 | 53.9 | 56.4 | 84.8 | 84.81 | 84.56 | 84.88 |
| 9 | Discharging | 23/09/2014 07:12 a.m. | 23/09/2014 07:22 a.m. | 00:09:42 | 3 | 58 | 53.5 | 57.13 | 69.58 | 57.13 | 69.58 |

The log records Charging, Discharging and Idle states, with start and end times, battery voltages, temperatures and state of charge and capacity values for each state change.

If the maximum number of entries is reached, the log purges the oldest entries first, allowing the most recent entries to be recorded.

2.22. BMM Data Log

The BMM automatically logs voltage, current (charge and discharge) and temperature as measured on the battery. The log keeps the last 18 days of activity, logging an entry once per minute. BMM Data Logs can be saved to file (CSV or XML) or erased from the BMM.



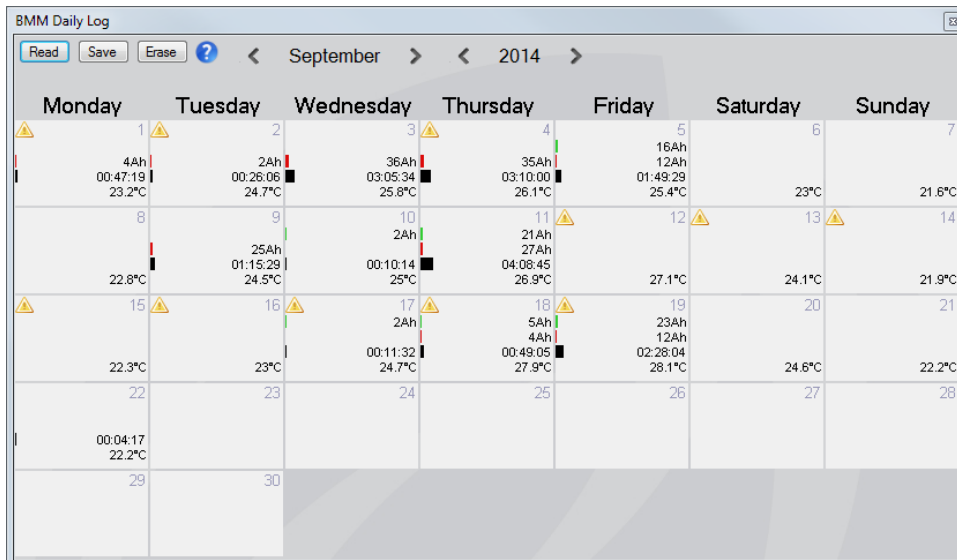
The resulting data is represented in the multiple-variable plot. Each data point is displayed in a scrolling table. Selecting a data point in the table also highlights that point on the plot.

Note: The BMM Data Log can contain more than 20,000 records and download times may exceed 20 minutes. Ensure the PC has adequate battery or AC supply during the Read process.

2.23. BMM Daily Log Licensed

The Daily Log allows a monthly overview of a daily summary of the battery status.

Each day displays total charge and discharge plot, and total charge time and average battery temperature for each 24 hour period. A specific month can be viewed using the month and year selectors.



Alarms active on any given day are indicated by the alert symbol. Click on the day of interest to view the specific alarm(s) for that day.

3. Charger Configuration

The FSx series charger can be operated in a number of different ways, depending on the configuration of the charger and battery modules.

Dedicated Profile Configuration

This is the standard single battery-type configuration (voltage, capacity and chemistry) and default configuration for the charger. The charger is manually configured for use with a single battery configuration and any battery may be charged provided the rating matches that of the charger configuration.

Alternate battery types cannot be charged without reconfiguring the charger appropriately.

Automatic Profile Configuration

Any battery module-fitted battery within the voltage and current capabilities of the charger can be connected and charged appropriately. The battery module provides the necessary profile information to the charger once the battery is connected.

3.1. Dedicated Profile Configuration

Configure a charger for use with a single battery type.

1. Select the **Charger Configuration** tab.
2. Select the correct battery type, voltage and capacity from the drop-down template menu.
→ If no battery types are available, click **Import CSV** to populate the drop-down menu from a CSV file.
3. Select the charger size and AC supply type from the two adjacent drop-down menus, click **Use Values**. The battery charging parameters will populate in the **Charger**

Configuration section.

4. Ensure the values are appropriate for the charging configuration and write the new configuration to the charger by clicking **Write Configuration**.
5. Use the **Verify Configuration** option to force check the installed hardware for suitability for the configuration.
6. The charger front panel will display the new rating details.
7. To print a rating label, click **Read Configuration** and then **Print Label**.

3.2. Automatic Profile Configuration

Configure a charger for Automatic Profile Configuration (APC). A battery fitted with a battery module is required to utilise an APC configured charger.

1. From the **Configuration** tab, select **APC Enabled (Single Profile)** or from the drop-down menu.
2. For dual profile charging select **APC Enabled (Dual Profile Capable)**.
3. Select the charger size and AC supply type from the two adjacent drop-down menus,

click **Use Values**. The battery charging parameters will populate in the **Charger Configuration** section.

4. Check that the values are appropriate for the charging configuration and write the new configuration to the charger by clicking **Write Configuration**.
5. The charger front panel will display **APC Enabled**.
6. Connecting a battery fitted with a battery module will automatically configure the charger for that battery.

3.2.1. Single and Dual Profile Charging

A charger may be connected to a battery module that is configured for either a Single or Dual Profile operation. The charger behaviour depends on both the module *and* charger configurations.

The charger must be **APC Enabled** to one of two types:

APC Enabled (Single Profile)

A charger set to **APC Enabled (Single Profile)** and connected to a battery module will perform a single profile charge.

Single Profile module:

Charges using the module's single Primary Profile

Dual Profile module:

Charges using the module's Secondary Profile, ignoring the Primary Profile.

APC Enabled (Dual Profile Capable)

A charger set to **APC Enabled (Dual Profile Capable)** and connected to a battery module will perform as follows.

Single Profile module:

Charges using the module's single Primary Profile

Dual Profile module:

Charges first using the Primary Profile followed by the Secondary Profile. The Primary Profile must be correctly configured to engage the secondary profile.

Single and Dual Profile Operation Summary

The table below shows the various configurations of module and charger configuration and the resulting profile that is used.

| | | Module Configuration | |
|---------------------------|----------------------|----------------------|---|
| | | Single Profile | Dual Profile |
| Charger APC Configuration | Single Profile | Primary Profile Only | Secondary Profile Only |
| | Dual Profile Capable | Primary Profile Only | Primary Profile Then Secondary Profile* |

* The Primary Profile in this case must be correctly configured to initiate the Secondary Profile.

3.2.3. Dual Profile Charge Example

A Dual Profile allows a battery to be charged with either of two profiles depending on how the charger is configured and how the profiles are set up.

An example would be a high demand battery requiring opportunity (bulk stage) charging from a high rate charger during a shift and a full charge (bulk charge with finishing stage) when connected to a standard charger.

In this scenario, the following configuration details must be in place:

1. The battery module is set for dual profile and the primary profile appropriately set with criteria for starting the secondary profile charge. (See Battery Module

Configuration, Section 4)

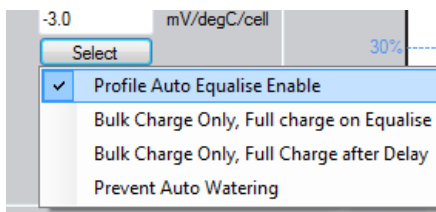
2. The high rate charger must be set for **APC Enabled (Dual Profile Capable)** from the Charger Configuration tab.
3. The standard charger must be set for **APC Enabled (Single Profile)** from the Charger Configuration Tab.
4. Alternatively, the high rate charger may also provide the secondary profile charge if left connected following a primary charge. The charger will provide a bulk charge based on the primary profile, and follow with the secondary profile depending on the selected criteria eg. a time delay.

3.3. Auto Equalise/Refresh

The Set by Profile option for Auto Equalise requires a number of steps to configure correctly.

Set by Profile

1. Select **Set by Profile** in the Configuration tab.
2. In the Charge Profiles tab, choose the active charge profile to modify and use the **Auto EQ/Refresh Options** button to select **Profile Auto Equalise Enable**.



3. Check the EQ/Refresh Current, Duration, and Max Cell Voltage values are appropriate.

4. Click **Write Profile**. The charger will now perform an equalise charge according to the EQ/Refresh values saved in the profile.

→ **Auto EQ/Refresh After** allows a cool down period before auto-initiated equalise charges. This includes Set by Profile, Cycle, Time or battery module based initiation.

→ **EQ/Refresh Lockout** enforces a period of no equalise following a standard charge completion. This is a global setting that applies to manual and any auto-initialised equalise charges.

Manual Equalise

The charger may be set to perform a one-time equalise charge on a connected battery.

1. Ensure the battery is connected. If currently charging, the charge cycle can remain in progress.
2. Hold the Enter button on the charger front panel until the display confirms an equalise charge has been set.

4. Battery Module Configuration

Single Profile Configuration

A Single Profile Configuration provides the profile details to the charger, and the charge is completed as per the Primary Profile. Typically this would be a conventional rate charge profile with appropriate finishing stages to ensure a healthy battery.

Dual Profile Configuration

A Dual Profile Configuration allows a battery to be charged with either of two profiles depending on how the charger is configured and how the module profiles are set up.

Typical use is a high-rate primary profile, followed by a conventional rate charge with finishing stages as a secondary profile.

The secondary profile starts only once criteria in the primary profile are met, such as after a time delay.

4.1. Single Profile

1. Select the **Battery Module Configuration** tab and choose the correct battery from the **Configuration Template** drop-down menu. Click **Use Values**.
2. Check the values populated below in the **Battery Ratings** section are correct and select **Single Profile**.
3. Set the Primary Profile Start Current (typically 16% of the rated battery capacity).
4. Set the Charge Profile appropriate for the battery and usage application.
5. Enter a battery **Identifier** and check the electrolyte and midpoint voltage probe options if applicable.
6. Check the Primary Profile parameters to ensure the profile is correct per the battery manufacturer recommendations.
7. Set any EQ/Refresh options desired.
8. Auto Equalise control is a charger-based setting, set on the **Charger Configuration** tab, and must be set to **Set by Profile** in order to use the battery module profile EQ parameters. Otherwise, the profile EQ settings are ignored.
9. Click **Write Configuration** to save the configuration to the battery module.

4.3. Dual Profile

A battery module may be configured to perform a primary profile charge such as a high rate opportunity charge, and follow with a secondary profile charge after some elapsed time or cycle count.

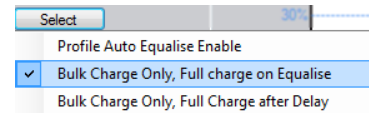
Alternatively, the battery may

be connected to a second charger configured just to charge a single profile - APC Enabled (Single Profile), in which case the secondary profile is used.

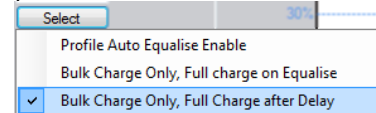
Configure a Battery Module for Dual Profile Operation

1. Ensure the battery module is configured for the battery ratings as per the Single Profile instructions above.
2. Select **Dual Profile** in the **Battery Ratings** section.
3. A new section will appear below called **Secondary Profile**.
4. In the **Primary Profile** and **Secondary Profile** sections, enter the required Start Current and Charge Profile for each Profile.
5. Select Primary Profile in the **Profile Parameters** section, and select the desired Profile Type.
6. Ensure the stage threshold values are appropriate for the battery and charge profile type. Select the **Auto EQ/Refresh Options** select box and choose the required Dual Profile behaviour:

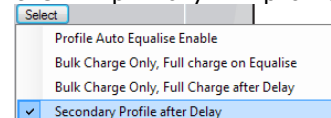
→ **Bulk Charge Only, Full Charge on Equalise** occurs according to the **Auto Equalise Settings** on the charger (Configuration tab).



→ **Bulk Charge Only, Full Charge after Delay** occurs according the delay specified in the **Auto EQ/Refresh After** parameter.

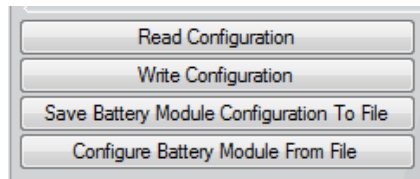


→ **Secondary Profile after Delay** allows the secondary profile to begin after the delay specified in the primary profile.



4.5. Backup and Duplicate a Module

Using the appropriate buttons in the **Battery Module Configuration** tab, a module configuration may be saved to file and loaded back from file. This process may be used to easily duplicate configurations across multiple modules. Configuration Access is required to save to and configure from file.



Save Battery Module Configuration To File

1. Connect the battery to the charger and ensure the software is communicating with the battery module. Select the **Battery Module Configuration** tab.
2. Confirm the module is communicating by clicking
3. Click **Save Battery Module Configuration to File**
4. The software will prompt for a save location and file name.

Read Configuration to display the module's current parameters.

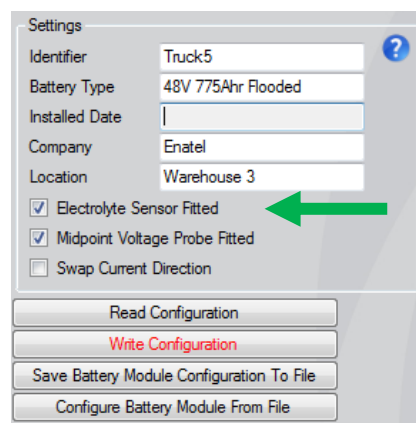
Configure Battery Module From File

1. Connect the battery to the charger and ensure the software is communicating with the battery module. Select the **Battery Module Configuration** tab.
2. Click **Configure Battery Module From File** and
3. Once the configuration is complete, click **Read Configuration** to confirm the module has the new configuration.

select the desired MPC file containing battery module configuration.

4.6. Electrolyte Level Monitoring

1. Select the **Module Configuration** tab and click **Read Configuration**.
2. Check the **Electrolyte Sensor Fitted** option and click **Write** to program the settings into the charger.
 - When the module determines the electrolyte level is low, an Electrolyte Level Low Alarm will be raised and an auto watering-enabled charger will receive an instruction to initiate a watering cycle, if connected to the battery.



4.7. Cell Imbalance Monitoring

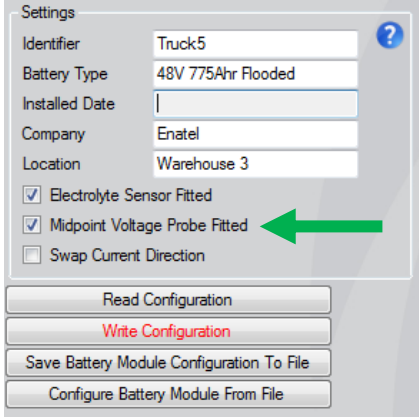
The Midpoint Voltage Sensor allows the battery module to detect voltage imbalance across the battery cells. The module flags a Cell Imbalance Alarm which, instructs the charger to perform an equalise charge at the next opportunity.

A charger may also be configured to provide an equalise charge according to a number of different rules. See Section 3.3 for more on charger-controlled equalise charges.

See Section 6.5 for details on the Cell Imbalance Alarm.

1. Select the **Module Configuration** tab and click **Read Configuration**.
2. Check the **Midpoint Voltage Probe Fitted** option.
3. Click **Write** to program the settings into the charger.
 - ➔ The battery module will now monitor the battery for cell imbalance, flagging the Cell Imbalance Alarm.

See the battery module documentation for Midpoint Voltage Sensor installation guidelines.



The screenshot shows a 'Settings' window with a light gray background. At the top left is the title 'Settings' and a blue question mark icon. Below the title are several input fields: 'Identifier' (Truck5), 'Battery Type' (48V 775Ahr Flooded), 'Installed Date' (empty), 'Company' (Enatel), and 'Location' (Warehouse 3). Below these fields are three checkboxes: 'Electrolyte Sensor Fitted' (checked), 'Midpoint Voltage Probe Fitted' (checked), and 'Swap Current Direction' (unchecked). A green arrow points to the 'Midpoint Voltage Probe Fitted' checkbox. At the bottom of the window are four buttons: 'Read Configuration', 'Write Configuration' (in red text), 'Save Battery Module Configuration To File', and 'Configure Battery Module From File'.

5. Firmware Bootloading

Updated firmware (embedded software) for either charger or battery module may be made available to address issues or add features. New firmware is loaded from PC to the device in a process called bootloading.

Bootloading requires Advanced Access.

Irreversible damage to the charger controller may occur if the bootload process is interrupted once underway. Bootloading should be performed with a reliable AC supply

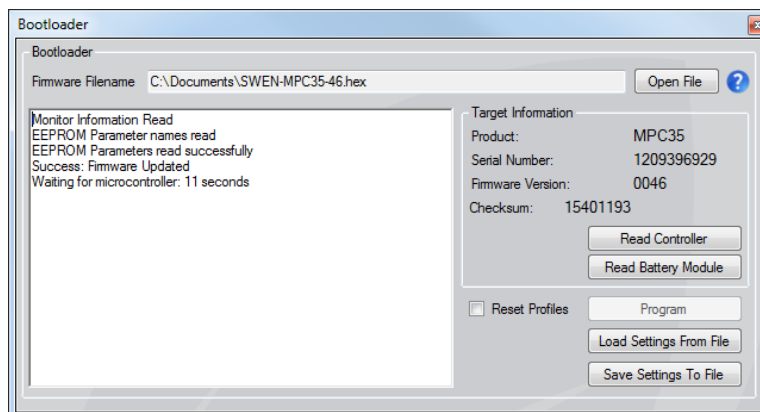
for both PC and charger. Ensure any automatic sleep or shutdown settings are disabled during bootloading.

Bootloading a Battery Module

Bootloading a battery module requires that the associated battery is connected to the charger. In this way the charger acts as a host to communicate with the battery module. Otherwise the process to bootload a module is the same as for that of a charger, as below.

Bootload Process – Charger or Battery Module

1. Connect to the charger USB port and confirm PC communication with the charger has been established. Open the **Bootloader** tab.
2. Click **Read Controller** or **Read Battery Module** to confirm the current target serial number and firmware version.
3. Click **Open File** to select the supplied HEX firmware file from the PC.
4. The software reads the selected firmware file and determines the appropriate target – charger or battery module.
5. Click **Program** to begin the bootloading process. Do not interrupt the power supply or connectivity to the charger, battery module or PC during this operation.
6. The display window will indicate a single line "SUCCESS" once the bootload is complete".
 - ➔ If bootloading a charger, the bootload should be checked by cycling the AC supply and confirming operation of the front panel display.



Additional Options

Reset Profiles

This option clears any profiles in the charger to the factory profiles included with the firmware.

Load Settings From File

As a part of the bootload process, the charger settings are automatically saved to the PC, and

loaded back to the charger before displaying "SUCCESS". This option allows manual selection of the settings file.

Save Settings To File

Charger settings can be manually saved to file for backup purposes.

➔ Battery module settings can be saved and loaded from the **Battery Module**

Configuration tab.

6. Alarms

6.1. Charger Related Alarms

Main Switch

Shows the status of the front panel start/stop switch. Default: Urgent

Inlet Filter

Can give a warning as to when the inlet filter needs servicing.
Default: Disabled

Low Mains

Indicates non-critical variation in the input mains voltage. May also indicate an overloaded charger module.
Default: Non-Urgent

Mains Fail

A mains supply loss situation and the charge cannot proceed. Default: Urgent

Non-Urgent Rectifier Fail

The charger is operating but a charger module has stopped, causing redundancy to be lost. Reduced power output and longer charge time as a result. Default: Non-Urgent

Urgent Rectifier Fail

If the number of power modules not providing output equals or exceeds the setting for urgent module count in Charger Interface monitor tab then the charger will stop. If the urgent module count is set to one then the charger is configured without redundancy and a single fault will stop the charge.
Default: Urgent

Module Over Temperature

Normally related to a blocked filter, restricted exhaust air or installation in an inappropriate location. Default: Urgent

Configuration Error

Charger cannot meet the target current required by the controller even with all fitted power modules operating. The configuration does not meet the limits set for a 10A or 15A mains input hardware limited charger. Default: Urgent

Output Fuse

Typically blown output fuses caused by connecting a reverse polarity battery to the charger. Check all cells for a reversed cable connection. After replacing a battery or charger cable always check the polarity before plugging the battery into the charger.
Default: Urgent

No Output Current

Charger is not providing the expected output current. Generally related to a premature disconnection of the battery, but also could be an incorrectly inserted power module.
Default: Urgent

Monitor ADC Fail

Internal checks on the MPC board indicate potential problems. MPC board should be tested and/or replaced.
Default: Urgent

APC Communications Fail

The battery module has failed to communicate with the charger.
Default: Urgent

APC Incorrect Voltage

Charger cannot produce the voltage required by the battery module.
Default: Urgent

APC Unknown Charger

Charger cannot find the required profile required by the battery module.
Default: Urgent

APC Water Level Low

For battery module equipped batteries, indicates the Electrolyte Sensor has detected a low level of electrolyte.
Default: Non-Urgent

APC Voltage Imbalance

For battery module equipped batteries, indicates the midpoint voltage varies from nominal by more than 0.5V. Battery module will schedule an equalize charge to rectify this variation. Default: Non-Urgent

6.3. Battery Related Alarms

Over Discharged Battery

Battery is still under 1.9Vpc after 30 seconds of charge. Indicates a faulty battery that needs investigation. Default: Urgent

Deeply Discharged Battery

Battery initially is under 1.9Vpc but recovers within 30 seconds of the charge cycle start. This alarm normally occurs when a battery is unplugged from the lift truck and immediately plugged into the charger. Default:Non-Urgent

Sulphated Battery

Battery fails to complete a de-sulphation profile applied by the charger correctly and generally means that the battery requires attention. Default: Urgent

Incorrect Battery

Battery is inappropriate for the configuration of the charger and cannot be charged without reconfiguring the charger to suit the battery. Default: Urgent

Bulk Charge Timeout

Battery has exceeded the maximum time allowed for the initial constant current bulk charge phase. Could indicate a faulty battery or the charger configuration is not correct for the size of battery. May need additional charger modules added to the charger. Default: Urgent

Finishing Charge Timeout

Battery has exceeded the maximum time allowed for the finishing part of the charge cycle. Common with new batteries with less than 10 charge cycles. If the alarm occurs regularly, investigation is advised and possible adjustment of the charger or service of the battery. Default:Non-Urgent

Battery Disconnected

Battery has been unplugged before charge cycle has completed. This can damage the battery connector and increase risks of ignition of battery charge gasses. If the battery needs to be disconnected mid cycle, the charger must be first set to **STOP**. A partial charge cycle will be logged. Default: Urgent

Reversed Battery

A battery with positive and negative cables reversed has been connected to the charger. Generally this will also cause an output fuse alarm and the need to replace the charger output fuse(s). Batteries should always first be checked for correct polarity BEFORE plugging onto the lift truck or a charger. Default: Urgent

Minimum dV/dt

Change in battery voltage over time. Alarm occurs when the change in voltage exceeds the value set in the profile settings. This alarm also indicates the termination of a successful charge. Default:Non-Urgent

Maximum Cell Voltage

Occurs when the voltage per cell exceeds the value set in the profile settings. Typically 2.7V per cell for lead acid batteries. Default:Non-Urgent

Batt Over Temp – Start

Occurs when the battery temperature measured before a charge profile starts exceeds the value set in the controller settings. This alarm will not allow the charge profile to continue. Default: Urgent

Batt Over Temp - Charge

Occurs when the battery temperature measured during a charge profile exceeds the value set in the controller settings. This alarm will allow the charge profile to complete. Default:Non-Urgent

+dI/dt

Occurs when the measured current in the constant voltage stage is rising instead of falling. This alarm will terminate the charge profile. Default: Urgent

Minimum Current

Occurs when using a IU profile and the current in the constant voltage stage falls below the value set in the profile settings. This alarm will not stop a profile and is considered normal for some types of batteries. Default:Non-Urgent

EQ/Refresh Timeout

Occurs when the time threshold in a given stage of the equalize profile has been exceeded. This alarm will terminate the equalize charge but is not considered an urgent alarm. Default:Non-Urgent

6.5. BMM Alarms

EEPROM Fail

The module has detected an unrecoverable internal error which may cause functionality and logging failures. Module should be replaced as soon as possible.

State of Charge Low

Battery charge is at or below the defined threshold. Thresholds are set in the Battery Module Settings tab. Default threshold is 20% of the rated capacity.

State of Health Low

Battery State of Health is calculated from the change in State of Charge over the expected number of charge cycles for the life of the battery. Default threshold is 20%.

Temperature Low

Battery temperature has reached the minimum threshold. Thresholds are set in the Battery Module Settings tab. Default threshold is 5°C/41°F.

Temperature High

Battery temperature has reached the maximum threshold. Thresholds are set in the Battery Module Settings tab. Default threshold is 55°C/131°F.

Cell Imbalance

Voltage difference between each half of the battery (positive post to midpoint and midpoint to negative post) must be below the set threshold. Thresholds are set in the Battery Module Settings tab. Default threshold is 0.5V.

Electrolyte Level

The electrolyte sensor (if fitted) has detected a low electrolyte level. This alarm can flag the battery to receive a top-up from an auto watering kit if fitted.

7. Appendix

7.1. Charge Profile Types

This section describes in detail each stage threshold that defines a charge profile type.

A charge profile type determines the number of stages and the type of current vs. voltage delivery for that stage.

7.1.1. IUIa

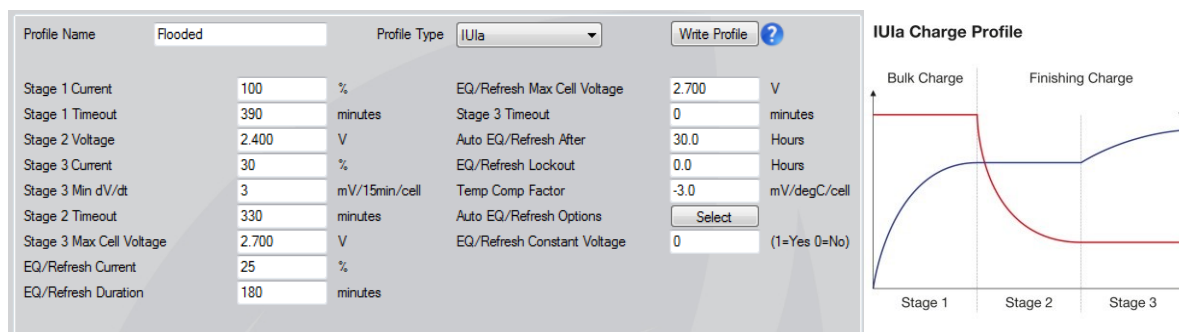
Most commonly used for charging flooded traction batteries, the bulk charge portion of the IUIa is also used for Opportunity Charging which can be initiated from the .csv file when configuring the charger.

The general shape of the IUIa profile is shown below. The first "I" stage, constant current, is commonly referred to as "Bulk Charge", where the bulk of the amp hours are returned to the battery. At the completion of the bulk stage the amp hours returned will be approx 80% of the total amp hours that will be returned by the completion of the full charge cycle.

The next "U" and "I" stages are commonly known as the "Finishing Charge" which provides the required overcharge to return the battery to its full capacity and ensure it is ready for

the next discharge cycle, without excessive temperature rise of the battery. The "U" part of the finishing cycle is constant voltage at or near the voltage when the battery starts gassing which allows the current to reduce to a point where it is safe for the battery to gas freely. The final "I" stage, again constant current, allows the battery to gas freely ensuring that the full capacity is restored.

The termination of the charge is determined by monitoring the rate of change of battery voltage over a 15 minute time frame, dV/dt . Different batteries and different states of charge perform slightly differently during the finishing charge and monitoring when the voltage stops rising is an accepted way of ensuring an optimal charge has been achieved.



Stage 1 Current

The percentage of the nominal charger current (set in the configuration) that is used for the bulk charge stage, normally set to 100%.

Stage 1 Timeout

Maximum time the charger will stay in bulk charge. If this time is exceeded the charger stops with a major alarm as it could indicate a faulty battery with short circuit cells. Whilst the setting is in minutes the timeout is actually calculated based on amp hours returned to the battery rather than just time, allowing a faulty charger module to reduce the charge current available and lengthen the bulk charge time accordingly.

Although a faulty power module should always be replaced, in most situations the charger will still complete a charge cycle with one module failed.

Stage 2 Voltage

The setting for the constant voltage stage, set in accordance with the battery technology depending on when a particular battery type starts to gas.

Stage 3 Current

The percentage of the nominal charger current to which the charge current needs to reduce to in order to transition to second constant current stage. The setting varies with the capability of the battery technology to accept current during gassing. This

setting is very important for sealed cells where it needs to be quite low to prevent the battery losing electrolyte and drying out.

Stage 3 Min dV/dt

Rate of change of battery voltage in mV/15min/cell used to determine the automatic end point of the charge cycle.

Stage 2 Timeout

Maximum time the charger will stay in the constant voltage stage of the cycle.

Stage 3 Max Cell Voltage

Maximum voltage the charger will reach in stage 3. It provides protection against applying too great a voltage to the battery. The occasional maximum voltage trips are not a major problem and the charge completes with a minor alarm. Regular maximum voltage trips occurring indicates that the battery needs attention.

EQ/Refresh Current

The percentage of the nominal charger current (set in the configuration) that is used for the equalization, normally set to quite a low value, typically 25% for a flooded battery, less for GEL or AGM.

EQ/Refresh Duration

The duration of the equalization.

EQ/Refresh Max Cell Voltage

The maximum charger output voltage during the equalize charge. Normally set to the same as the Stage 3 max cell volts but can also be a little higher to allow more headroom for a full equalize to occur.

Stage 3 Timeout

The maximum time the charger will stay in the constant current gassing part of the cycle. This time can vary when the battery is new. Whilst it is necessary to provide a limit to the time, the occasional finishing charge timeout is not a major problem resulting in only a minor alarm indication. Should Finishing Timeout errors be regular then the battery should be investigated. It is not always necessary to have separate stage 2 and stage 3 timeouts. If the stage 3 timeout is set to zero then the stage 2 timeout is used as the combined stage2/3 limit.

Auto EQ/Refresh After

Time that the battery needs to remain

connected to the charger for it to initiate an auto equalize cycle. Normally set to 30 hours to allow an equalization over a weekend period.

EQ/Refresh Lockout

The minimum time following the completion of a charge cycle, before an equalize can start. This is sometimes a requirement of battery charger specifications to allow for the battery to cool before applying an equalize charge. When the lockout is set then this is the minimum time between charge complete and equalize even if the equalize is manually initiated.

Temp Comp Factor

Temperature compensation factor used to adjust the chargers voltage setting to allow for different battery temperature. Measured in mV/(°C/°F)/cell. Normal setting for lead acid batteries is -3.0

Auto EQ/Refresh options

Some profile type selections allow the following Auto Equalize options. Auto Equalize must be enabled in the Configuration tab.

Profile Auto Equalise Enable

When selected, the equalize options are enabled, operating with the EQ/Refresh Current, EQ/Refresh Duration, EQ/Refresh Lockout and Auto EQ/Refresh After parameters.

Bulk Charge Only, Full Charge on Equalise only

Select when opportunity charging using battery modules. Initiates a full charge whenever an equalise charge is set to occur.

Bulk Charge Only, Full Charge after Delay

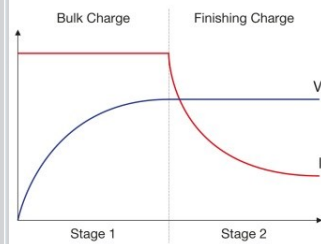
Select when opportunity charging using battery modules. Initiates a full charge plus equalize charge whenever the battery remains connected after the specified delay.

EQ/Refresh Constant Voltage

If enabled, the Refresh Maximum cell Voltage is used as a limit and the refresh current will reduce to maintain the battery voltage at the Max cell Voltage until the Refresh Duration times out. If disabled then the refresh charge will terminate when the Max Cell Voltage is reached.

| Profile Name | | Profile Type | | Write Profile ? | |
|---------------------|-------|--------------|-----------------------------|-----------------|---------------|
| Flooded | | IUa | | | |
| Stage 1 Current | 100 | % | EQ/Refresh Max Cell Voltage | 2.700 | V |
| Stage 1+2 Timeout | 390 | minutes | Stage 1 Timeout | 0 | minutes |
| Stage 2 Voltage | 2.400 | V | Auto EQ/Refresh After | 30.0 | Hours |
| Minimum Current | 30 | % | EQ/Refresh Lockout | 0.0 | Hours |
| Stage 2 Timeout | 330 | minutes | Temp Comp Factor | -3.0 | mV/degC/cell |
| EQ/Refresh Current | 25 | % | Auto EQ/Refresh Options | Select | |
| EQ/Refresh Duration | 180 | minutes | EQ/Refresh Min dV/dt | 0 | mV/15min/cell |
| | | | EQ/Refresh Constant Voltage | 0 | (1=Yes 0=No) |

IUa Charge Profile

**Stage 1 Current**

Percentage of the nominal charger current (set in the configuration) that is used for the bulk charge stage, normally set to 100%.

Stage 1+2 Timeout

Maximum total elapsed time in minutes that the charger will deliver charge to the battery. In an IU profile it is normally required to limit the total time in stage 1&2

Stage 2 Voltage

Setting for the constant voltage stage, set in accordance with the battery technology depending on when a particular battery type starts to gas. This is an important voltage and should take into account temperature, ideally with active compensation of the battery voltage with the measured battery temperature.

Stage 2 Timeout

This gives the ability to limit the maximum time the charger will stay in the constant voltage stage of the cycle. Normally set to 0 with the combined Stage1+2 Timeout being used.

Minimum Current

Once the charge current in Stage 2 drops below this value the charge cycle will terminate and the battery ready light will be illuminated. This gives the ability to promptly terminate the charge should the battery be in a high state of charge without having to wait for the Stage1+2 timeout before indicating the battery is ready.

EQ/Refresh Current

The percentage of the nominal charger current (set in the configuration) that is used for the refresh, second constant current stage, actual setting depends on the battery type and application.

EQ/Refresh Duration

The duration of the Refresh charge, be it only constant current or a combination of constant current and constant voltage.

EQ/Refresh Max Cell Voltage

The maximum charger output voltage during the refresh charge. Can either be a trip or a second constant voltage stage depending on the setting of EQ/Refresh Constant Voltage.

Stage 1 Timeout

Gives the ability to have a separate timeout for Stage1, normally not used.

Auto EQ/Refresh After

Time that the battery needs to remain connected to the charger to initiate a Refresh cycle. The actual setting depends on the battery and the application.

EQ/Refresh Lockout

Gives additional protection against a Refresh charge starting without adequate battery cool down time.

Temp Comp Factor

Factor used to adjust the chargers voltage setting to allow for different battery temperature in mV/(°C/°F)/cell. In high rate applications the setting of temperature compensation is quite important and may need to be adjusted to suit the battery type and application.

Auto EQ/Refresh options

Some profile type selections allow the following Auto Equalize options. Auto Equalize must be enabled in the Configuration tab.

Profile Auto Equalise Enable

When selected, the equalize options are enabled, operating with the EQ/Refresh Current, EQ/Refresh Duration, EQ/Refresh Lockout and Auto EQ/Refresh After parameters.

Bulk Charge Only, Full Charge on Equalise only

Select when opportunity charging using battery modules. Initiates a full charge whenever an equalise charge is set to occur.

Bulk Charge Only, Full Charge after Delay

Select when opportunity charging using battery modules. Initiates a full charge plus equalize charge whenever the battery remains connected after the specified delay.

EQ/Refresh Min dv/dt

The rate of change of battery voltage in mV/15min/cell used to determine the automatic end point of the refresh

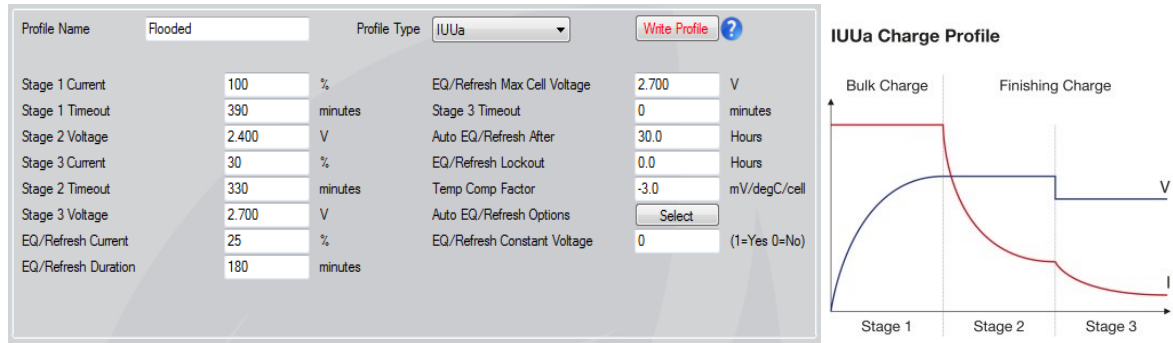
cycle if the refresh voltage does not reach the Refresh Max Cell Voltage.

EQ/Refresh Constant Voltage

If enabled, the Refresh Maximum cell Voltage is used as a limit and the refresh current will reduce to maintain the battery voltage at the Max cell Voltage until the Refresh Duration times out. If disabled then the refresh charge will terminate when the Max Cell Voltage is reached.

7.1.4. IUUa

This profile is an option for infrequent charging of AGM traction batteries.



Stage 1 Current

Percentage of the nominal charger current (set in the configuration) that is used for the bulk charge stage, normally set to 100%.

Stage 1 Timeout

Maximum time the charger will stay in bulk charge. If this time is exceeded the charger stops with a major alarm as it could indicate a faulty battery with short circuit cells. Whilst the setting is in minutes the timeout is actually calculated based on amp hours returned to the battery rather than just time, allowing a faulty charger module to reduce the charge current available and lengthen the bulk charge time accordingly.

Although a faulty power module should always be replaced, in most situations the charger will still complete a charge cycle with one module failed.

Stage 2 Voltage

Setting for the constant voltage stage, set in accordance with the battery technology depending on when a particular battery type starts to gas.

Stage 3 Current

Percentage of the nominal charger current to which the charge current needs to reduce to in order to transition to second constant voltage stage.

Stage 2 Timeout

Maximum time the charger will stay in the first constant voltage stage of the cycle.

Stage 3 Voltage

Setting for the second constant voltage stage.

EQ/Refresh Current

The percentage of the nominal charger current (set in the configuration) that is used for the refresh, second constant current stage, actual setting depends on the battery type and application.

EQ/Refresh Duration

The duration of the Refresh charge, be it only constant current or a combination of constant current and constant voltage.

EQ/Refresh Max Cell Voltage

The maximum charger output voltage during the refresh charge. Can either be a trip or a second constant voltage stage depending on the setting of EQ/Refresh Constant Voltage.

Stage 3 Timeout

Maximum time the charger will stay in the second constant voltage stage.

Auto EQ/Refresh After

Time that the battery needs to remain connected to the charger to initiate a Refresh cycle. The actual setting depends on the battery and the application.

EQ/Refresh Lockout

Gives additional protection against a Refresh charge starting without adequate battery cool down time.

Temp Comp Factor

Factor used to adjust the chargers voltage setting to allow for different battery temperature in mV/(°C/°F)/cell. In high rate applications the setting of temperature compensation is quite important and may need to be adjusted to suit the battery type and application.

Auto EQ/Refresh options

Some profile type selections allow the following Auto Equalize options. Auto Equalize must be enabled in the Configuration tab.

Profile Auto Equalise Enable

When selected, the equalize options are enabled, operating with the EQ/Refresh Current, EQ/Refresh Duration, EQ/Refresh Lockout and Auto EQ/Refresh After parameters.

Bulk Charge Only, Full Charge on Equalise only

Select when opportunity charging using battery modules. Initiates a full charge whenever an equalise charge is set to occur.

Bulk Charge Only, Full Charge after Delay

Select when opportunity charging using battery modules. Initiates a full charge plus equalize charge whenever the

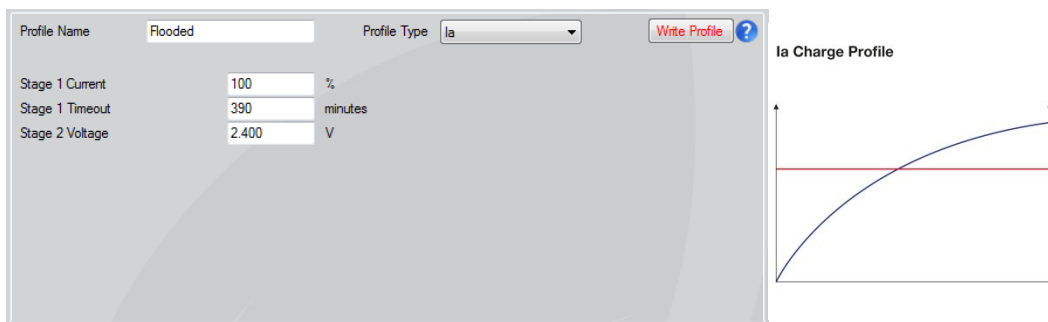
battery remains connected after the specified delay.

EQ/Refresh Constant Voltage

If enabled, the Refresh Maximum cell Voltage is used as a limit and the refresh current will reduce to maintain the battery voltage at the Max cell Voltage until the Refresh Duration times out. If disabled then the refresh charge will terminate when the Max Cell Voltage is reached.

7.1.6. Ia

This profile type has been included as a maintenance tool to be used at a workshop level for carrying out maintenance charge on damaged batteries and is not a charge profile intended for regular charging of traction batteries.



Stage 1 Current

Percentage of the nominal charger current (set in the configuration) that is used for the bulk charge stage, normally set to 100%.

Stage 1 Timeout

Maximum time the charger will stay in bulk charge. If this time is exceeded the charger stops with a major alarm as it could indicate a faulty battery with short circuit cells. Whilst the setting is in minutes the timeout is actually calculated based on amp hours returned to the battery rather than just

time, allowing a faulty charger module to reduce the charge current available and lengthen the bulk charge time according. Although a faulty power module should always be replaced, in most situations the charger will still complete a charge cycle with one module failed.

Stage 2 Voltage

When the charger output voltage (per cell) reaches this level, the charge is terminated and the green light is illuminated.

7.3. Charge Profile Default Parameters

| PROFILES | DEFINITION | COMMENTS/DEFAULT SETTINGS |
|----------------|--------------------------------|---|
| Flooded | Flooded lead acid Cell | Normal flooded traction batteries |
| Profile type 1 | IUIa | Constant current, constant voltage, constant current |
| Var 0 = 100 | Stage 1 Current (%) | Allowable range to AS 2548 is 0.12 to 0.3xBattery C5 rating |
| Var 1 = 390 | Stage 1 Time Out (minutes) | Calculated on Ahrs to allow for a module being out of service |
| Var 2 = 2400 | Stage 2 Vpc (x1000) | 2.4Vpc temp compensated |
| Var 3 = 25 | Stage 3 Current (%) | 30% max 20% min, typically 25% |
| Var 4 = 3 | Stage 3 dv/dt (mV/cell/15mins) | Setting for the dv/dt termination |
| Var 5 = 330 | Stage 2 Time Out (minutes) | 330mins combined stage 2+3 timeout |
| Var 6 = 2700 | Stage 3 Max Vpc (x1000) | 2.7Vpc, charge stopped when reached |
| Var 7 = 12 | Equalize Current (%) | Typically 12% >20% gives max voltage trips during equalize |
| Var 8 = 120 | Equalize Duration (minutes) | Equalize Duration (minutes) 120mins |
| Var 9 = 2700 | Equalize Max Vpc (x1000) | 2.7Vpc |
| Var 10 = 0 | Stage 3 Time Out (minutes) | Flooded uses a combined timeout for stage2+3 |
| Var 11 = 30 | Auto Equalize After (minutes) | Auto EQ starts after being connected to the charger for this time |
| Var 12 = 4 | Equalize Lockout (hours) | Lockout inhibit after charge complete for a manual equalize cycle |
| Var 13 = 30 | Temp Comp Factor | Compensation of -3mV/cell/°C, Centre Temperature 25degC |
| Var 14 = 0 | Sulphate Detect | Sulphate Detect Auto sulphate detect function active 1=yes 0=no |
| Var 15 = 0 | Auto Equalize | Auto Equalize Auto equalize function active |
| | | |
| GEL | GEL cell | Suitable for Evolution GEL cell batteries |
| Profile type 1 | IUIa | Constant current, constant voltage, constant current |
| Var 0 = 100 | Stage 1 Current (%) | Recommended setting is 0.17xBattery C5 rating, Max is 0.2xC5 |
| Var 1 = 360 | Stage 1 Time Out (minutes) | Calculated on Ahrs to allow for a module being out of service |
| Var 2 = 2350 | Stage 2 Vpc (x1000) | 2.35Vpc temp compensated |
| Var 3 = 6 | Stage 3 Current (%) | 6% |
| Var 4 = 3 | Stage 3 dv/dt (mV/cell/15mins) | Setting for the dv/dt termination |
| Var 5 = 270 | Stage 2 Time Out (minutes) | 270mins, 4.5hrs |
| Var 6 = 2600 | Stage 3 Max Vpc (x1000) | 2.6Vpc, charge stops if reached |
| Var 7 = 3 | Equalize Current (%) | 3% |
| Var 8 = 120 | Equalize Duration (minutes) | 120mins, 2hrs |
| Var 9 = 260 | Equalize Max Vpc (x1000) | 2.6 |
| Var 10 = 180 | Stage 3 Time Out (minutes) | 180mins, 3hrs |
| Var 11 = 30 | Auto Equalize After (minutes) | Auto Eq starts after being connected to the charger for this time |
| Var 12 = 4 | Equalize Lockout (hours) | Lockout inhibit after charge complete for a manual equalize cycle |
| Var 13 = 30 | Temp Comp Factor | Compensation of -3mV/cell/°C, Centre Temperature 25degC |
| Var 14 = 0 | Sulphate Detect | Auto sulphate detect function active 1=yes 0=no |
| Var 15 = 0 | Auto Equalize | Auto Equalize Auto equalize function active 1=yes 0=no |

| AGM-Ch | Champion | Suitable for manufacturer specific motive power batteries |
|------------------|----------------------------------|---|
| Profile type 1 | IUIa | Constant current, constant voltage, constant current |
| Var 0 = 100 | Stage 1 Current (%) | Typically 0.15xBattery C5 rating, Max 0.2xC5 |
| Var 1 = 390 | Stage 1 Time Out (minutes) | 390mins, 6.5 hours |
| Var 2 = 2370 | Stage 2 Vpc (x1000) | 2.37Vpc temp compensated |
| Var 3 = 19 | Stage 3 Current (%) | 19% |
| Var 4 = 3 | Stage 3 dv/dt (mV/cell/15mins) | Setting for the dv/dt termination |
| Var 5 = 210 | Stage 2 Time Out (minutes) | 210mins, 3.5hrs, safety for a combined stage 2+3 |
| Var 6 = 2550 | Stage 3 Max Vpc (x1000) | 2.55Vpc, charge stops if reached |
| Var 7 = 10 | Equalize Current (%) | 10% |
| Var 8 = 120 | Equalize Duration (minutes) | 120mins |
| Var 9 = 2550 | Equalize Max Vpc (x1000) | 2.55Vpc |
| Var 10 = 0 | Stage 3 Time Out (minutes) | Champion only use a combined timeout for stage2+3 |
| Var 11 = 30 | Auto Equalize After (minutes) | Auto Eq starts after being connected to the charger for this time |
| Var 12 = 4 | Equalize Lockout (hours) | var12=4 Equalize lockout (hours) 4 hours |
| Var 13 = 30 | Temp Comp Factor | Compensation of -3mV/cell/°C, Centre Temperature 25°C |
| Var 14 = 0 | Sulphate Detect | Auto sulphate detect function active 1=yes 0=no |
| Var 15 = 0 | Auto Equalize | Auto equalize function active 1=yes 0=no |
| | | |
| ConstCurr | Constant current charging | Commissioning charge of a flooded motive power battery |
| Profile type 2 | Ia | Constant current until time or max volts limits are reached |
| Var 0 = 30 | Stage 1 Current (%) | Uses 30% of the rated based on nom current set to 0.2xC5 |
| Var 1 = 300 | Stage 1 Time Out (minutes) | 300mins 5hrs, stops provided it doesn't hit max volts first |
| Var 2 = 2700 | Stage 2 Vpc (x1000) | Shutdown limit, Hits max volts and stops |
| Var 3 = 0 | Stage 3 Current (%) | Not used in Ia profile |
| Var 4 = 0 | Stage 3 dv/dt (mV/cell/15mins) | Not used in Ia profile |
| Var 5 = 0 | Stage 2 Time Out (minutes) | Not used in Ia profile |
| Var 6 = 0 | Stage 3 Max Vpc (x1000) | Not used in Ia profile |
| Var 7 = 0 | Equalize Current (%) | Not used in Ia profile |
| Var 8 = 0 | Equalize Duration (minutes) | Not used in Ia profile |
| Var 9 = 0 | Equalize Max Vpc (x1000) | Not used in Ia profile |
| Var 10 = 0 | Stage 3 Time Out (minutes) | Not used in Ia profile |
| Var 11 = 0 | Auto Equalize After (minutes) | Not used in Ia profile |
| Var 12 = 0 | Equalize Lockout (hours) | Not used in Ia profile |
| Var 13 = 0 | Temp Comp Factor | Not used in Ia profile |
| Var 14 = 0 | Sulphate Detect | Not used in Ia profile |
| Var 15 = 0 | Auto Equalize | Not used in Ia profile |

| AGM-M | AGM-M charging | For charging AGM motive power batteries |
|----------------|--------------------------------|---|
| Profile type 3 | IUa | Constant current, constant voltage, constant voltage |
| Var 0 = 100 | Stage 1 Current (%) | Stage 1 uses the full nominal rating of the charger |
| Var 1 = 300 | Stage 1 Time Out (minutes) | Calculated on Ahrs to allow for a module being out of service |
| Var 2 = 2450 | Stage 2 Vpc (x1000) | 2.45Vpc |
| Var 3 = 30 | Stage 3 Current (%) | Trip point from stage 2 (U) to stage 3 (I) |
| Var 4 = 0 | Stage 3 dv/dt (mV/cell/15mins) | Not used in IUa profile |
| Var 5 = 60 | Stage 2 Time Out (minutes) | 60mins, 1hrs |
| Var 6 = 2300 | Stage 3 Max Vpc (x1000) | 2.30Vpc constant voltage temp comp until stage 3 time out |
| Var 7 = 6 | Equalize Current (%) | 6% |
| Var 8 = 120 | Equalize Duration (minutes) | 120mins |
| Var 9 = 2450 | Equalize Max Vpc (x1000) | 2.45Vpc |
| Var 10 = 300 | Stage 3 Time Out (minutes) | 300mins, 5hrs |
| Var 11 = 30 | Auto Equalize After (minutes) | Auto EQ starts after being connected to the charger for this time |
| Var 12 = 4 | Equalize Lockout (hours) | 4 hours |
| Var 13 = 30 | Temp Comp Factor | Compensation of -3mV/cell/°C, Centre Temperature 25°C |
| Var 14 = 0 | Sulphate Detect | Auto sulphate detect function active 1=yes 0=no |
| Var 15 = 0 | Auto Equalize | Auto equalize function active 1=yes 0=no |
| | | |
| AGM-R | AGM-R charging | Charging reserve batteries or using as a power supply |
| Profile type 4 | IUa | Constant voltage current limited profile with a time off function |
| Var 0 = 100 | Stage 1 Current (%) | Stage 1 uses the full nominal rating of the charger |
| Var 1 = 720 | Stage 1 Time Out (minutes) | 720mins, 12 hours |
| Var 2 = 2350 | Stage 2 Vpc (x1000) | 2.35Vpc |
| Var 3 = 0 | Stage 3 Current (%) | Not used in IUa profile |
| Var 4 = 0 | Stage 3 dv/dt (mV/cell/15mins) | Not used in IUa profile |
| Var 5 = 0 | Stage 2 Time Out (minutes) | Not used in IUa profile |
| Var 6 = 0 | Stage 3 Max Vpc (x1000) | Not used in IUa profile |
| Var 7 = 0 | Equalize Current (%) | Not used in IUa profile |
| Var 8 = 0 | Equalize Duration (minutes) | Not used in IUa profile |
| Var 9 = 0 | Equalize Max Vpc (x1000) | Not used in IUa profile |
| Var 10 = 0 | Stage 3 Time Out (minutes) | Not used in IUa profile |
| Var 11 = 0 | Auto Equalize After (minutes) | Not used in IUa profile |
| Var 12 = 0 | Equalize Lockout (hours) | Not used in IUa profile |
| Var 13 = 0 | Temp Comp Factor | Not used in IUa profile |
| Var 14 = 0 | Sulphate Detect | Not used in IUa profile |
| Var 15 = 0 | Auto Equalize | Not used in IUa profile |

7.4. Glossary

| | |
|-------------------|---|
| ADC | Analogue to Digital Converter, internal controller hardware to convert measurements into digital signals for processing |
| AGM | Battery that the electrolyte is held in the separators between the plate, fitted with a pressure relief value so it only vents under unusual circumstances |
| AGM-Ch | Charge profile suitable for a particular type of AGM battery |
| AGM-M | Charge profile suitable for charging AGM batteries being used in Motive Power Applications |
| AGM-R | Charge profile suitable for charging AGM batteries being used in Reserve Power Applications |
| Aux TX | Auxiliary transformer used to provide power to the MPC controller when no battery is connected to the charger |
| Backplane | Printed circuit board with connectors and components to connect the power modules to the charger housing |
| bootload | Setting a microprocessor in a condition where you can load or update its firmware |
| bulk charge | The first stage of a charge cycle where the charger is outputting maximum current to recharge the battery as quickly as possible. Stage completes when the voltage reaches a nominal 75-80% state of charge |
| C5 | Battery capacity at the 5 hrs rate to 1.7Vpc for a motive power battery |
| Charger Interface | PC software application required to communicate with the MPC controller |
| charger module | The core module that converts AC power into DC power suitable for charging a battery |
| configuration | Setting the necessary adjustments of the MPC Controller to suit the battery and charging application |
| Data.csv | CSV file containing the information for configuring the charger to suit a battery, must be in the same directory as the MMPC Interface application |
| din rail | Clip on mounting method for fixing electrical components to metalwork |
| diode | Electronic component that only passes current in no direction |
| DOD | Depth of discharge, measure of the battery discharge condition, 100% is totally discharged |
| dv/dt | Rate of change of voltage, slope of the change in voltage against time |
| efficiency | Ratio of output power to input power of an electrical device, the higher the efficiency the less energy is lost as heat |
| equalize | Maintenance function using a low constant current charge to ensure all cells in the battery have similar voltages |
| equalize lockout | Timer to prevent an equalize charge starting after a normal charge until the battery has had time to cool down |
| finishing charge | The stage(s) that follow the bulk charge to return the battery from 80 to 100% state of charge which must be done more slowly than the bulk charge stage |
| Firmware | Computer code that is embedded in a microprocessor |
| flash | Process where the firmware is written into the microprocessor's FLASH memory |
| Flooded | Batteries that have liquid electrolyte that can freely vent, also referred to as wet cell batteries |
| FS3 | FS3 Frame Size 3 modular charger that can accommodate up to 3 power modules |
| fuse | Easily replaced device that internally melts during an electrical fault to prevent damage to other components |
| FW | FW Abbreviation for Firmware |
| GEL | Battery that the electrolyte is trapped in a silica gel, fitted with a pressure relief value so it only vents under unusual circumstances |
| harmonics | Higher frequency components being multiple of the 50hz AC power that may damage or degrade the performance of electrical equipment |

| | |
|--------------------------|--|
| HF | High frequency, a generic term for switch mode battery chargers used in motive power applications |
| Ia | Charge Profile with constant current control and automatic termination |
| IUa | Charge Profile with constant current, then constant voltage control and automatic termination |
| IUIa | Charge Profile with constant current, then constant voltage, then constant current control and automatic termination |
| IUUa | Charge Profile with constant current, then constant voltage, then constant voltage control and automatic termination |
| LED | Light emitting diode, a solid state light source that does not wear out |
| micro controller | Computer in a single chip |
| MMPC | Modular Motive Power Charger |
| motive | Battery application used in moving plant and being regularly used and then recharged by connecting to a battery charger |
| MP130 – MP330 | 3kW Motive charger modules |
| MPC | Motive Power Controller, 35/37 |
| NET Framework | Microsoft Library of pre coded solutions required for the MMPC Interface software to run |
| neutral | The fifth wire in a three phase plug |
| PCB | Printed circuit board used to mount and connect together electronic components |
| phase | Identification of the 3 lines of electrical power that make a 3phase supply, referred to as A,B,C or 1,2,3 |
| Power factor | A measure of the effectiveness of an electrical device to convert volt-amperes to watts, PF=1 is best |
| charger module | The core module that converts AC power into DC power suitable for charging a battery |
| profile_template.txt | Text file that contains all the profile templates for the different voltage, time etc parameters of the charge profiles |
| profile_types.txt | Text file that contains the default profile types, IUIa, IUUa etc |
| rectifier | Another name for the charger module |
| reserve | Battery application where the batteries are generally on float charge, only being discharged during AC power outages |
| reversed battery | Battery/charger must be connected positive/positive and negative/negative, reversed connection will blow the fuses |
| RJ45 | 8 pin modular connector used for the control cabling between the MPC31 controller and the backplane |
| SB350 | 350A Anderson Power connector type SB |
| SOC | State of charge, measure of the battery charge condition, 100% is fully charged |
| software | PC application that is installed on a host computer to communicate with the MPC controller |
| sq mm or mm ² | Measure of the cross sectional area of an electrical cable, large enough to carry the required current without overheating |
| sulphated | Battery plates have built up a hard sulphate layer which prevents the battery charging and discharging properly |
| switched mode | Power conversion process using rapid turning on and off of a regulating device to achieve high efficiency and small size |
| temp comp | Temperature compensation where the charging voltage is adjusted for the ambient temperature operating conditions |
| termination | When the charge cycle completes |
| timeout | Timer used to protect against abnormal conditions |
| txt | text file format |
| urgent alarm | Alarms that stops a charge from completing, battery may not be charged, battery cannot be used |

| | |
|-----------------|---|
| USB driver | Universal Serial Bus driver necessary to allow the host computer to communicate with the controller |
| VD Compensation | Compensation of the charging voltage to allow for voltage drop in the cabling from the charger to the battery |
| Vpc | Voltage per cell, total battery voltage divided by the number of cells |

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